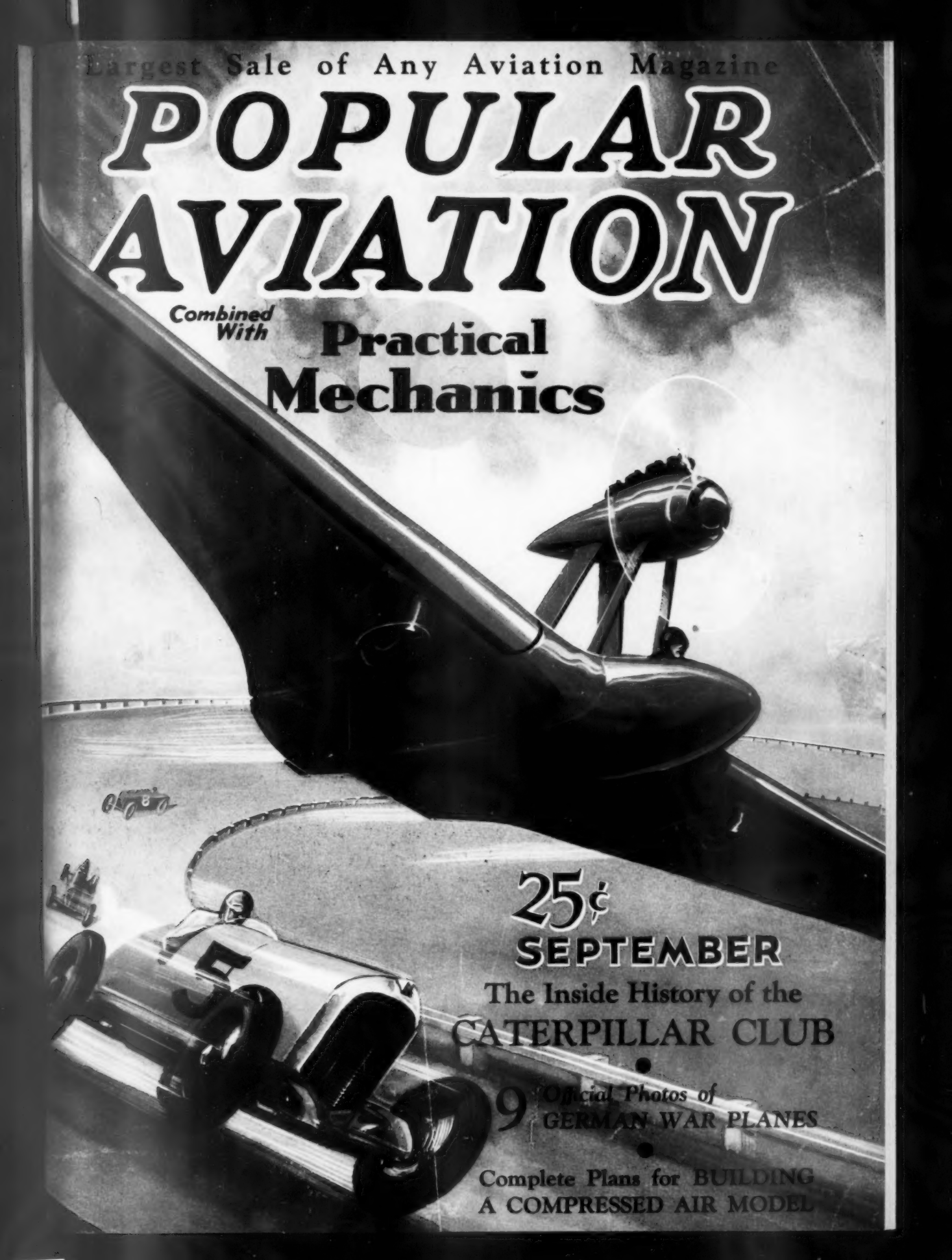
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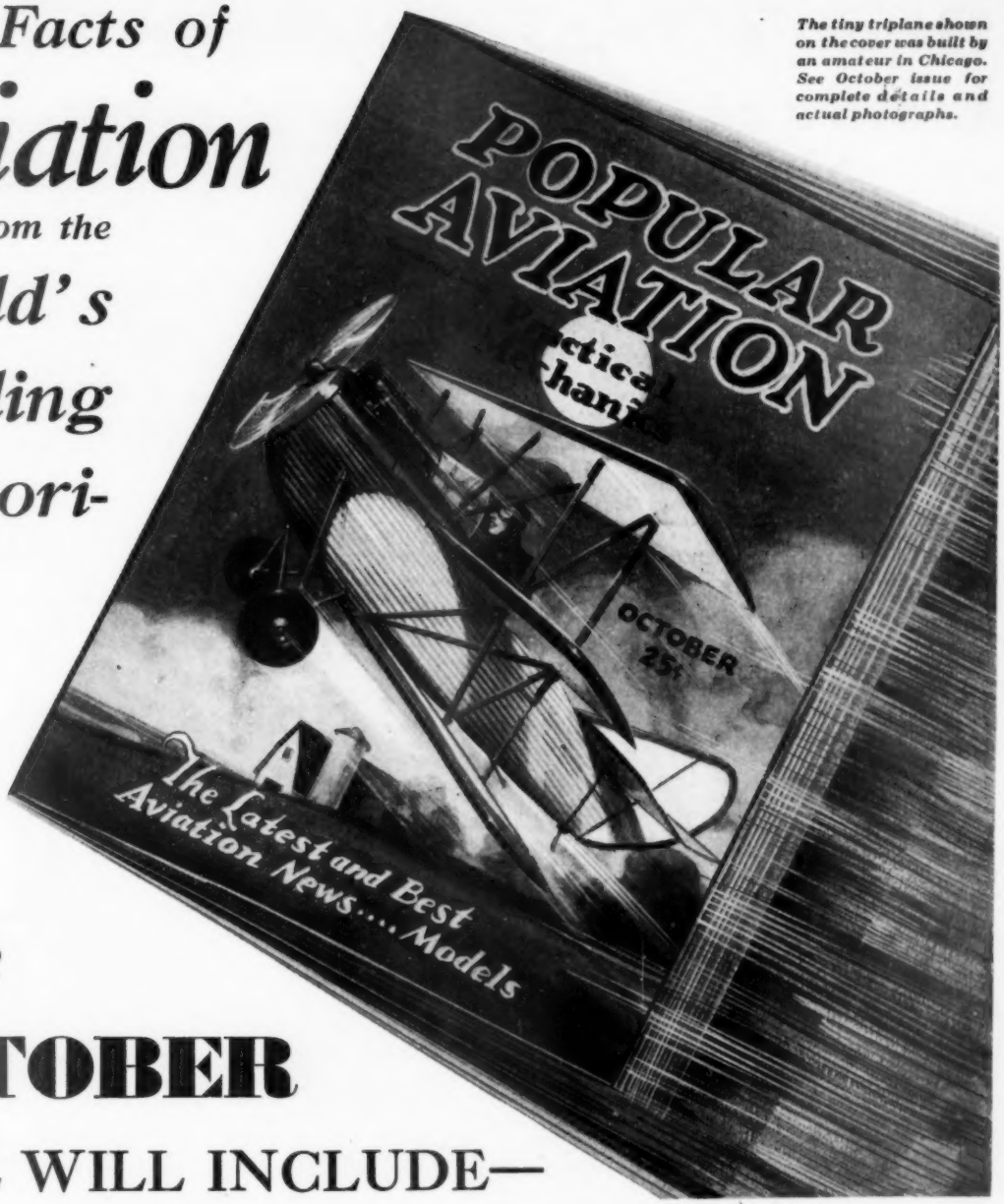


*The tiny triplane shown on the cover was built by an amateur in Chicago. See October issue for complete details and actual photographs.*

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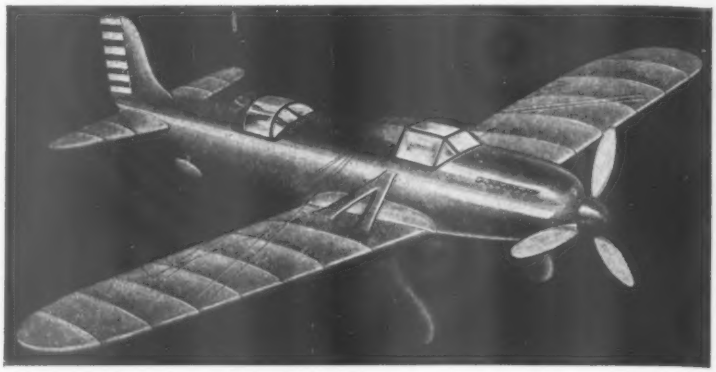

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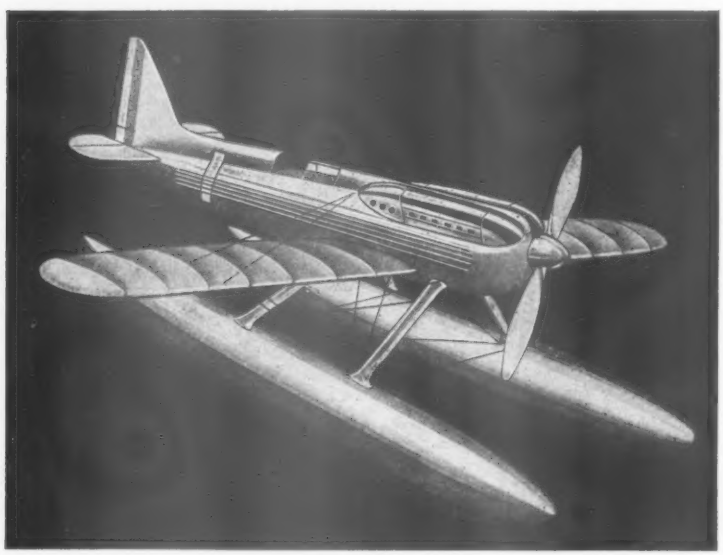

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# An Airy Chat With the Editor

THINGS have not been so bad in aviation this summer as they might have been—everything considered. Of course, there have been times when everyone has had more money to play around with than during this season, but that lack of surplus funds did not stop a lot of the ardent enthusiasts from building a lot of ships.

Right here in Chicago, I have seen two very original lightplanes, and have had a full description of two more which will be of great interest to our readers as soon as the inventors and designers give us permission to run a description of their brain children. The designers have let their imagination run wild and have literally departed miles from conventional practice. You'll hear about them later.

* * *

AND there are persistent rumbling rumors of a new gasoline turbine engine that is said to walk rings around anything in the engine line yet constructed. We have not yet had the pleasure of seeing this machine, but hope to get a break in the near future, and when we do get the dope we will pass it on to you—pronto.

* * *

YOU have probably noticed that we have opened up an annex to the Airy Chat, known to fame as the "Howl Department for Amateurs". All of the many comments on lightplane legislation that were formerly run in the Airy Chat now have a department all of their own. Hope you like it.

* * *

I WONDER how the National Air Races are going to turn out, and whether the coveted 400 m.p.h. will be reached? If any one succeeds in getting anywhere near this mark, which has been predicted by a few wise ones, I'll sure collapse when I hear the news. There have been the usual rumors that always preceed this event, that there will be a mighty improvement in the speed at the races, but when we pass the 300 m.p.h. mark, it takes a whole lot of improvement to add a few miserly m.p.h. to a ship's speed.

* * *

OUR government, although hard-up, is still going in for dirigibles in a big way, though most of the Powers have definitely abandoned the idea. I don't see what they are good for, nor how we can afford to play around with doubtful projects costing several million dollars—in these days—but we're doing it just the same. You'll find a mighty interesting article on this subject if you will page back and read what Mr. Mitchell has to say on this subject of long dispute.

* * *

OUR genial cover artist, Herman Bollin, is giving the lightplane phans a treat these days. The cover on this issue shows the new French tailless plane that is creating so much comment in Europe. For our next issue he will draw a wonderful little Chicago production—a miniature all-metal triplane that shows great promise.

While not tailless, the little triplane might be called "partless" since the constructor has done away with many parts hitherto considered essential to any well behaved ship. For example, there are no wing ribs nor fuselage longitudinals. And there are a lot of other old familiar parts missing.

* * *

JUST out of curiosity, the other day, I added up the total airplane photo collections that have been submitted to us from time to time. The total number of photographs owned by our readers amounts to the amazing sum of 96,800 photos. Great heavens, I didn't know before that there were that many photographs on earth, let alone airplane photos! Now comes the present photo champ, John C. Wyatt. Let's hear his story.

*I noticed in August's issue of P. A. that George Loudermilk, of Chicago, Ill., challenged A. A. Askew's record of 1,599 photographs. Loudermilk claims the record with 2,188 photos.*

*I now offer my challenge, I have twenty-two thousand, five hundred fourteen photos (22,514). I think I hold the record to date. I have been collecting photos for the past seven years and they are in 10 very large books. I use International Tailoring Co.'s sample books. The pages in them are 18x20 inches. If it should be necessary I can forward you authentic proof to my statements.*

*Please print this in your Airy Chat columns and if there is someone who can surpass my record let's hear from them.*

*I certainly think your magazine the best there is. I read most all of the aviation magazines but there is none that can come up to, or surpass. Keep those war plane pictures coming, they are sure great.*

* * *

HERE are a few more statistics—if you can stand them. An engine running an average of 1,600 r.p.m. runs 14,400,000 revolutions between 150 hour overhauls. If of the eight cylinder type, its magneto produces 57,600,000 sparks in the same length of time. If you don't believe it, count them!

* * *

NOW we have a kicker from the West, E. Gustafson, Anaconda, Montana. By rights this letter should go in the Howl Department, but as it is the only and solitary example of the kind, I'll run it here. Mr. Gustafson has no sympathy with our stand in the defense of amateur builders — that's certain. Here we go—

*Say, what is your magazine coming to? On one page you feel sorry for the inspectors and on the next page you kick about regulations on lightplane building.*

*In Mr. C. A. Clarson's statement, he must want the Federal government to let the amateur plane builder do as he pleases, use the materials he wants, fly anything that he would like to. Can't some of these drug-store pilots and plane builders use some common sense and be their age?*

*Some of these goofs you would think was a bunch of eight-year-old kids.*

*If the Federal government let these bathroom guys do as they please they would be flying the darndest contraptions and coffins ever put into the air. You know, as well as anyone, that when a kid starts anything like that he will use the cheapest stuff he can get a hold of, and throw it together so he can fly it.*

*And show off to a bunch of girls so they will admire one of U. S.'s most famous pilots, if he has the guts to fly it. It may go into a tail spin and bust the famous pilot's neck or cripple him for life.*

*A lot of these guys stand on the ground and watch a plane fly over their heads, then they are going to build a plane and show up these big airplane companies. Nothing but a two-bit idea. If they keep it up, the undertaker won't kick.*

(Continued on page 200)

# POPULAR AVIATION

*Combined with* Practical Mechanics, Including Aeronautics and Aviation Stories and Mechanics

A Magazine for the Promotion of Amateur Aviation and Private Flying

Volume XI | SEPTEMBER, 1932 | Number 3


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# Is the Dirigible

*By*

HARLEY W. MITCHELL

*Former Editor*

*of*

POPULAR AVIATION

With accurate modern aircraft-artillery, it is a simple matter to register repeated hits on a slow moving dirigible.

"Caught in the lights," a wonderful target for the anti-aircraft guns.

SINCE the days of the Montgolfier brothers, tragedy has dogged the footsteps of every advance in the construction and operation of lighter-than-air craft.

Have these holocausts and stupendous accidents been unavoidable and inherent in experimenting with a new and hazardous art, or are they an essential part inherent of the art itself? Are millions being spent on a foolhardy course with lighter-than-air craft?

What are the events and facts that possibly point to the truth—not those which occurred in the early days, but fairly recent ones that have stunned the advocates of the dirigible?

* * *

ON A quiet evening in October, 1930, a long, cigar-shaped monster slid out of its hangar at Cardington, England, attended by a swarm of soldiers, mechanics, groundkeepers, guards and officers.

It was a great day for the R-101, for a precious cargo was to be entrusted to it. Not a cargo of gold, or oriental fineries, or pre-war rum for the "States", but a cargo of notables—the elite of Britain's air ministry.

Aboard were such notables as Lord Thomsen, Secretary of State for Air; Sir Sefton Brancker, Director of Civil Aviation; Wing Commander R. B. B. Colmore, Director of Airship Development, and Major Bishop, Chief Inspector for the Air Ministry.

In addition there was a picked crew of 49 officers and men. Some were taking their first dirigible flight, others their second or third. But all were taking their last flight.

The people of Great Britain eyed this flight with concern. On one hand was confidence and pride based on the record of the R-101's sister ship, the R-100. "Was not the R-101 as precisely constructed as the R-100? Did it not represent the best of British engineering?"

On the other hand were those who had doubts. They recited the terrible tragedy of the R-38, which broke over Hull and fell into the river Humber. It, too, had been a quiet, peaceful day, and the former ZR-2 had floated back and forth over the heads of gaping spectators in towns and hamlets.

Nor was this the only case they cited. The R-33 had been torn from its moorings at Pelham in 1925 and swept hundreds of miles over the North Sea by a gale. Only a succession of miracles of airmanship and heroism had brought the ship back.

Suddenly, the R-101 burst like a flaming comet. A terrific detonation struck the ears of the horrified crowd as they watched the two halves of the ship descend like flaming meteors.

NEXT morning, the R-101 lay on a hillside near Beauvois, France, a gigantic mass of twisted wreckage. Out of the grotesque heap, a saddened nation attempted to recover their dead and to find some clue as to what had happened. Had the hydrogen exploded? Had the framework collapsed?

The report of the Committee of Assessors, headed by Sir John Simon, stated: "The disaster of the R-101 was caused by a substantial loss of gas from one of the forward bags which followed the ripping, by the gale, of the forepart of the outer envelope. No failure in the structure or the control system nor faulty navigation could be evidenced."

This holocaust sounded the death knell to lighter-than-air craft in England. Blimps were sold for junk with the exception of a few used for observation purposes. The R-100, one of the finest dirigibles built and the largest of its time, was scrapped. The engines, fabric, and gas tanks, however, were retained by the air ministry.

This ship, the R-100, had made an impressive flight to Canada and return in 1929. In 1930 it made a speed record of 81.5 miles per hour, beating the record of the Graf Zeppelin.

This last experiment of Great Britain, the R-100 and the R-101, had cost

Two planes easily conquered this dirigible and sent it down in flames at the recent British Aircraft Pageant.

# Utterly Worthless?

the round sum of $10,000,000, including the mooring masts in India, Canada, and Egypt.

It was generally believed, except in Germany, that after Great Britain turned thumbs down on lighter-than-air craft, both as a war weapon and as a freight carrier, that other nations would follow suit, condemning the dirigible as an impractical craft and a menace.

AS A weapon it was not so formidable as one could expect. The World War record of the Zeppelins was reviewed, and suffered in comparison with airplanes. The controllability of the giant craft was so erratic as to make operation hazardous. Its size made it an easy target for enemy aircraft which could easily outperform it in speed and maneuvering.

The operation of so large a craft required a small army of workers on the ground and a considerable personnel in the air. Its shelter was so conspicuous that it offered a magnificent target for enemy attack.

In reply to the many arguments justifying the use of the dirigible as an airplane carrier and refueling base, English aeronautical engineers stated that the cruising range of the dirigible, though of considerable magnitude, was of no consequence since the craft itself was not dependable. Furthermore, it too, required a base for mooring where repairs could be made.

The condemnation went beyond this. As the size of dirigibles increased, the enterprise of mooring and casting off became increasingly difficult. Masts, other equipment and a large corps of ground men were required. In a gale, or stormy weather it becomes a gigantic task to secure the nose of a dirigible to a mast. More than once a sudden gust of wind has swept the craft upwards, carrying men up with it—sometimes to be dashed to their deaths.

As a refueling base, the British said, it did have certain advantages, but not sufficient to warrant the spending of millions.

It is even at the present time averred, that although the constructional problem of the dirigible is a serious one, the problems of operation are even more difficult.

There has been comparatively little experimentation and research in the landing and launching of dirigibles. The number of trips is a pitifully small figure on which to base conclusions. The greater part of the life of a dirigible is spent in its tremendously expensive shed, waiting for favorable weather.

CROSS-winds, blowing at right angles to the axis of the dirigible shed, produce serious conditions—hard to combat when the dirigible is to be docked or removed from the hangar for flight. When the ship is, say, half in and half out of its hangar, there is a terrific strain set up in the structure at a point in line with the hangar entrance. The housed part is under no stress, while the exposed surface of the forward part meets the force of the wind, its very length acting as a lever against the section at the entrance.

For instance, the R-101, although built to withstand much greater stresses in the air, could only pass a 20 miles per hour cross-wind housing test without showing signs of dangerous strains.

In mooring masts, England was far ahead of both the United States and Germany since they had employed such devices since 1909, when Air Commander E. A. D. Masterson of the R-1 introduced them. From that time on, England progressed in the science of mooring masts until 1930.

At the time of the R-101 disaster, she had the most efficient method of handling dirigibles at her stations in India, Egypt, Howden, and Cardington. And yet, in spite of these practical advances, she abandoned the dirigible, condemning it as an impractical craft.

England used a high mast of approximately 200 feet for securing the ship. The ship approached the tower into the wind until it was approximately 200 feet to the leeward at an altitude of 500 feet. A cable was then run out from the mast tip to the ground, directly under the ship's nose.

A cable was then dropped from the ship's nose and joined to the mast cable. The ship was then permitted to lose way until the cables were taut. Then the cranking apparatus in the tower was started, and the ship was gradually towed close to the mast tip.

Two other cables were then dropped from aft on either side of the dirigible and fastened to ground cables. Then the ship was hauled down to a horizontal position and the nose brought almost up to the mast. The coupling is a movable arm, free to swing about so there need be no danger of bringing the nose too close.

After the coupling was attached the after part of the ship was weighted down with heavy rollers. The weight of the rollers is sufficient to hold the ship down under normal wind conditions. If a strong gust of wind occurred, the ship might lift the rollers from the ground, compensating the strain of the wind.

IN THE face of all these developments and precautions against accident, British engineers pronounced the operation of a dirigible a serious risk and a detriment to human safety. They went further—they gave good reasons. First of all, snow and ice on a dirigible is a serious matter while it is moored to a mast.

Again, in spite of the fact that the mooring rollers were a dependable enough device, serious accidents could occur while the nose was being fastened and the rollers adjusted. A sudden gust of wind, for example, might develop a sudden load at the nose.

Attacking the stub mast system (which is now being used in the United

*WHILE taxes are mounting and becoming an insufferable burden, our Naval department is throwing away good money on the construction and maintenance of rigid dirigibles. These floating "pork-barrels" have been proved highly dangerous and useless by other major nations, including France, England, and Italy.*

*We therefore demand that Congress cease appropriating money for this extravagance, which is getting us nowhere so far as the national defense is concerned. With $5,375,000 appropriated for the "Akron", $2,450,000 for her sister ship, the "Macon", and other millions spent for docks, helium plants and other equipment, we are not accomplishing much, except contributing to the prosperity of a few manufacturers who are the beneficiaries of this spending orgy.*

COMPARATIVE TABLE OF WORLD'S LARGEST DIRIGIBLES

| | Los Angeles | Graf Zeppelin | Akron | R 100 | R 101 |
|---|---|---|---|---|---|
| Nominal Gas Vol. in cu. ft. | 2,470,000 | 3,700,000 | 6,500,000 | 5,000,000 | 5,000,000 |
| Length Overall (ft.) | 658.3 | 776.0 | 785.0 | 709.0 | 724.0 |
| Maximum Diameter (ft.) | 90.7 | 100.0 | 132.9 | 133.0 | 131.8 |
| Height Overall (ft.) | 104.4 | 113.0 | 146.5 | 141.0 | 139.0 |
| Gas Used in Cells | Helium | Helium | Helium | Hydrogen | Hydrogen |
| Gross Lift in lbs. | 153,000 | 258,000 | 403,000 | 343,000 | 340,000 |
| Useful Lift in lbs. | 60,000 | 110,000 | 182,000 | 160,000 | 154,000 |
| Number of Engines | 5 | 5 | 8 | 6 | 5 |
| Total Horsepower | 2,000 | 2,750 | 4,480 | 3,600 | 3,250 |
| Fuel Used | Gasoline | Gasoline† | Gasoline | Gasoline | Oil |
| Maximum Speed, Knots | 63.0 | 80.0 | 72.0 | 69.5 | 65.0 |
| Cruising Range* in miles | 3,860 | 5,300 | 9,200 | 6,200 Naut. Mi. | 6,000 Naut. Mi. |

Above, one of the tiny airplanes is being launched from the "Akron," a difficult feat and one that is not frequently attempted.

In the circle, we see one of the landing crew clinging perilously to a line after being carried aloft accidentally. His companion not so fortunate, lost his hold and dropped to his death.

States) British engineers said that while the stub mast brought the ship close to the ground, simplifying maintenance, many more men were required than with the high mast and that weather conditions had to be even better to permit good landings. In the case of strong winds, which might require casting off, so that the ship did not batter herself to pieces against the ground, the ship was too close to the ground to permit such a maneuver with safety.

In the stub mast system, the ship is still pulled down by man power—which should by this time be obsolete. The mast at Lakehurst, N. J., is of the tower type. At Frederichshafen, on Lake Constance, Germany, they use the stub mast with a trolley car at the rear to enable the ship to swing about freely.

In the U. S., at present, a motorized stub mast has been introduced. The object is greater facility and speed in connecting the ship to its moorings and the reduction of the ground crew. The ship is not moved in and out of its shed as often as when the stationary mast is used. This motorized mast system weighs 130 tons, and is constructed on a tripod system with a 240 horsepower gas engine caterpillar tractor on each leg.

The corners, or legs, are spaced on a 100 foot circle, the two rear tractors furnishing the driving power and the forward one guiding the whole unit about the field, in addition to furnishing part of the motive power.

OF ALL the German Zeppelins turned over to the Allies after the war, the two turned over to Italy were broken up, the two surrendered to the British kept on the inactive list, while France used only one. The Dixmude seemed to carry the curse on every ship the Allies took away from Germany. The Mediteranneé, sister ship of the Dixmude, was also destroyed.

The Dixmude, formerly the L-72, was the largest dirigible in the world at that time. In 1923 it flew across the Mediterranean Sea in a successful and commendable flight, returning with much experimental knowledge and navigation data. In December of that year, it again took off on another cruise to the tropics and was last seen on December 21, about ninety miles north of Biska, Northern Africa.

She had been warned not to attempt the return trip to France, owing to heavy gales over the Mediterranean. No one knows what happened but it may be surmised. On December 27, fishermen pulling in their nets, discovered the body of Lieut. de Grenedan, commander of the Dixmude. No wreckage was ever found.

Probably, in the gales, the Dixmude had been battered—some important structural member collapsed or the Dixmude caught fire and the sea swallowed the evidence. After this disaster France lost her interest in lighter-than-air craft and confined her attention to the building and operating of airplanes.

ITALY, after the success of the Norge, 1926, in its 4,000 mile flight, which included a jaunt across Alaska ad the North Pole, built the Italia, a true full rigid—for the Norge was really a semi-rigid type.

In the spring of 1928, the Italia, commanded by General Umberto Nobile, left Spitzbergen for a reconnaissance of the Artic. She carried a crew of sixteen. While flying above Cape Leigh Smith in Northeast Land, it grounded and was wrecked, the main gondola remaining on the ice. The rest of the ship, with this heavy car released, jerked into the Arctic gloom with six men on board and disappeared from sight, never to be seen again.

Dr. Finn Malmgren, a Swedish scientist, lost his life trying to reach land with two Italian survivors. Captain Roald Amundsen and five others took off in a specially built plane in a rescue attempt and were never heard from again.

Eight of the crew of the Italia were saved and eight died, including the six lost with the hull. General Nobile was among those saved. This wreck, one of the most costly in the history of aeronautics—not because the ship itself was lost, but for the expenditure of blood and treasure and the loss of Amundsen, the greatest of all Arctic explorers—caused Italy to lose faith in the dirigible. She did little with them thereafter.

The Roma, also an Italian-built ship, was constructed for the United States government. Helium was scarce at that time and was used only for long cruises or important reconnaissance work. Consequently, hydrogen was fed into the cells of the Roma for a short training cruise at Hampton Roads, Va., in February, 1922.

It had flown for a comparatively short time and was preparing to land when the rudder, with its vertical controls broke, precipitating the craft to earth.

The metal clad nose of the Roma struck some high-tension electric wires and a terrific explosion followed. Two majors, four captains, seven lieutenants and twenty-one non-commissioned men were burned beyond recognition.

BUT THIS is not the only tragedy in the annals of lighter-than-air craft in the United States. The R-38 had carried seventeen officers and men to their deaths as they were taking a final test cruise before accepting the craft from the English shops where it had been built for the United States.

It is safe to conclude that hydrogen shares generously in fixing the blame for many of these terrific catastrophes. Gasoline for motive fuel and hydrogen for buoyancy make a dangerous combination.

Slight leaks from the gas cells may be ignited by sparks from the engine exhausts. In electrical disturbances there is a constant threat.

But many disasters can also be laid to faulty operation and many to structural failure.

Today's modern dirigible carries helium in its cells, It is an inert gas, non-combustible, but much more expensive than hydrogen. There is a much smaller seepage loss through the cell fabric.

Atmospheric conditions, heat, humidity, and the like, affect lifting power, a rain soaked envelope weights the ship down.

RETURNING to the subject of structural failures, we must review the case of the Shenandoah. This ship sailed for Lakehurst on September 3, 1925, and crossed into Ohio during the night with no difficulty.

It was commanded by Lieut. Com. Zachary Lansdowne, U. S. N., and cast off with a complement of forty-two officers and men. The Shenandoah, "Daughter of the Stars", was the first dirigible built and launched in the United States, and was considered the "ultimate" in craft.

But in central Ohio it met a "line squall". This is a high wind where the currents of air are moving mostly vertically. No one can estimate the tremendous wrenching power of two opposed currents of air.

The Shenandoah was literally twisted in two. The rear section dropped slowly and landed a short distance away. The control car was severed from the forward section and dropped to earth, killing the commander and eight of the crew. The forward section, now free of the weight of the control car, was operated as a free balloon by Lieut. Com. Rosendahl, later commander of the Akron, aided by Lieut. Meyer and brought safely to earth two miles away. The dead numbered four officers and nine members of the crew, while three were badly injured.

Charges and counter-charges were made. Some said that the ship had been weakened by repairs and readjustments and was sent on the mission against the protests of the commander.

The official court of inquiry showed a difference of engineering opinion, although it was generally conceded that the ship's structure was not strong enough to withstand vertical air currents of such magnitude.

Activities were abandoned for some time, but with England still taking steps toward an active fleet, and Germany apparently making progress, the government ordered a new ship, the Los Angeles from the Zeppelin Corporation. It was completed in 1928 and delivered to Lakehurst, N. J., by Commander Eckner after an adventurous sea voyage.

Of all dirigibles, the Los Angeles has come nearest to justifying the time and treasure spent upon it. It has done much to restore a reasonable amount of faith in the discredited dirigible. It has been moored to the mast of a ship at sea.

It perhaps set the stage for the great Graf Zeppelin's voyages. But it has done nothing phenomenal. Its cruises have been neither long nor numerous. Compared with even a rooky pilot, its crew have few hours in the air to their credit.

**The wartime Zeppelin L-39 just after being shot down at Campiegne, France, showing that the dirigible was not immune from danger even in those days of primitive anti-aircraft equipment.**

THE YEAR 1929 was perhaps the greatest year for dirigibles. The Graf Zeppelin made a 21 day cruise around the world; work was begun on the ZRS-4 and the ZRS-5 (the former now the Akron), and the Los Angeles logged more miles to her credit. The R-100 and the R-101 were completed. But the great year was soon over, and soon the R-101 was wrecked, the R-100 junked and Britain, France and Italy joined hands in a taboo on the dirigible.

A development of some interest, although it created little change in current construction, was the completion of the all metal MC-2, after six years of research and experimentation. The Hill riveting machine, which to all effects "sews" metal together, set 5,000 rivets per hour with less than a third of one percent error. The ship made a few minor flights, one of 600 miles, using helium in its cells. It has never been used for anything except minor training, because of its small load capacity.

The first demonstration of attaching a plane to a dirigible was made at the National Air Races in 1929, when a Vought observation plane, piloted by A. W. Gordon, contacted a "trapeze" apparatus on the Los Angeles and delivered a passenger.

The ZRS-4, now the Akron, has a trapeze apparatus, which can attach five scout planes and carry them in its hangar. It is an integral part of the structure, while on the Los Angeles it was merely an experimental accessory.

The Akron, completed in 1931, is the largest ship in the air. It was made by the Goodyear-Zeppelin corporation, employing a combination of German and American scientists and engineers. In the Akron the engines are within the hull, necessitating a powerful ventilating system with special blowers for intake and crankcase ventilation.

It has tilting propellers and a condensation system to balance loss of weight by fuel consumption. In the first device, the propellers can be tilted through an arc of 90 degrees from horizontal, permitting an upward thrust of 6,000 pounds, or a downward one of 10,000. The engines are reversible.

The second feature condenses water from the exhaust, thereby offsetting the loss of weight from the burned fuel, and avoiding the valving of expensive gas.

Steam forms a great part of the exhaust gases from the engine due to the burning of gasoline which is a hydrocarbon. The oxygen of the air combines with the hydrogen of the gasoline, and in this way, a great volume of vaporized water or steam is produced. This is then condensed, and a certain portion is retained as ballast for counteracting the loss of weight of fuel.

THE McNary-Parker bill, the cause of much congressional dispute during the past two years, would provide legal status for airships in interstate commerce and authorize the letting of air mail contracts. Much cannot be said about the commercial fate of the airship until this bill is disposed of.

As the matter now stands, the dirigible has not the confidence of those who should know. To pass over many obvious faults, such as proportion of pay load to cost of ship and such defects as its grounded time during windy weather, it presents no arguments for adoption in comparison with the already proven and acceptable airplane.

Is the government about to foist on the taxpayer another set of subsidies in the guise of mail contracts which will benefit no one except a few contractors? Is a discredited, dangerous, and impractical system to receive moneyed support at the expense of the airplane? Ask Congress, ask the lobbies —no one can tell.

END

## This Plane Is to Attempt World Flight

Showing the Moth monoplane destined for a 4,000 mile tour.

THIS "Moth" plane was built at Springfield, Mass., for Mr. and Mrs. Frank J. Lynch, who will fly it on a 40,000 mile trip around the world.

A close examination will show that the wings are of an unusual outline or "aspect", being deeply elliptical in form—with a gap at the body. The vertical surfaces are decorated with painted veins, evidently to carry out the "Moth" idea.

The landing gear is of the stiff leg type without external bracing, which fits it for landing in brush or rough fields.

## Rene Fonck, the French Ace of Aces

Capt. Rene Fonck, in his "civies", has recently proved an inventor as well a pilot. His invention will be described in a forthcoming issue.

PRACTICALLY everyone, including soldier and civilian alike, has heard or read about Captain Rene Fonck. He was the daring intrepid French Ace of Aces, who crowned himself with undying glory by his daring and spectacular exploits in the air against the best of the German pilots during the recent World War.

He was greatly feared by all of the enemy pilots, for with a string of over eighty planes brought down to his credit, they tried to evade him and slip out of his reach when they thought that they might get cornered by his crafty maneuvering.

Captain Fonck delighted in air combat—it was his very life. The mention of one enemy plane just merely brought a faint smile. But, with a dozen or more in the air when he happened around—well, that was just beginning to get exciting. It gave him an excuse to take to the air and possibly to engage in a fairly exciting sky battle. He very rarely worried about the outcome. He feared nothing, for luck seemed to be with him and he always came out the victor. Like a giant eagle, he daily soared into the higher altitudes waiting for its prey.

Above all, Captain Fonck knew his plane—knew how to handle it with ease and precision in all emergencies. He very rarely made a mistake, always squeezing out of the tightest holes in record time. He was unusually skilled in air-maneuvering and he deeply enjoyed the air. Cool and indifferent to what transpired on the ground, in the air he was the master aviator, pilot and observer. We might say, the master of them all—barring none.

One of the most daring and spectacular air battles in which Captain Fonck was engaged, happened at Cantigny, several days before the big American offensive against the enemy began. The guns of the Sixth Field Artillery, First Division, went into position at Coullemelle, Somme, on May 9th, 1918.

German observation planes were un-

(*Continued on page* 194)

## The DO-X to Have Rotors

SAFELY back in Germany after its year long air cruise to America, the great Dornier airliner, Do-X will undergo a period of experimentation to make this type of ship available for regular crossings.

Besides the fourteen members of its crew, the Do-X carried back models of the Volf Rotor Impeller, designed by Dr. Christian A. Volf of New York City and Copenhagen—a well known scientist. Two principal experiments with the rotor will be made at the Dornier works in Germany.

One experiment will be the insertion in the wings (fairly close to the cockpit) of a rotor fan "well" on each side. The other will be the building of an almost wingless plane using rotors to lift the plane from the ground and then, by moving the position of the rotors, using them as propellers.

The mechanical features of these two operations were worked out by Dr. Volf recently and both Captain Frederick Christiansen, commander and Captain Niemann, navigator, expressed the belief that the high speed rotors would have an important place in aviation.

Dr. Volf explained that a lesser strain on the wings and a greater lift is the object of rotors in the wings. He said it will be proven possible to use wing rotors, either connected with the engine or without. Without air, either the forward motion of the plane and the upward pressure of the air will turn the rotors, setting up a "lift" similar to a gyro-plane.

In its return flight from Holyrood, Newfoundland, the Do-X consumed nearly all of its 7,000 gallons of fuel. It was reported that the giant airliner consumed more fuel in one hour of flight than did Amelia Earhart Putnam's plane in its entire flight of about 2,000 miles. The wing rotors for this type of ship will be designed so as to overcome the weight of the ship, thereby increasing its range and decreasing the fuel supply to its twelve motors.

American visitors to the great ship, while it was moored at North Beach during the winter, were amazed at its massiveness. Particularly were they impressed with its control room. While there were many instruments and controls, they were so systematically arranged that any transport pilot could, with a few minutes' instruction, take charge of it.

Captain Christiansen did not consider the American visit a failure. While there were hopes that United States interests might purchase the ship, business conditions undoubtedly were a factor in allowing it to fly back to Germany unsold. Before leaving, however, he expressed satisfaction at the reception accorded the ship here and the interest it created in great planes of its type.

He stated that the new rotor would be developed not only for airplane but airship structures.

## Solo Regulations in Britain for Pilot Test

THE AIR student in Great Britain is filling the flying schools, it being a required social accomplishment among the wealthy classes. The fee in the fashionable schools is about $1,200. The culmination of the lessons takes place in the license test. The student has passed the preliminary stages, and has had about 2½ air hours solo.

He must ascend to a "height of not less than 2000 feet in an aircraft of which he is the sole occupant", shut off his engine, and glide back to his landing field and stop within 150 yards of a predetermined point. The student is checked by a recording barograph, which will show both height attained and whether the engine was revived in making his glide down, and also the climbing skill of ascent.

The air-speed indicator and the instrument-board altimeter are the student's guide. He must also keep an eye on the airport, or he will lose it. He wisely climbs higher than the altimeter showing, to make sure that the concealed barograph registers the required 2000 feet, as the two instruments do not always agree. He judges the point of shut-off, and feels his way to the landing field by means of his air-speed indicator, holding the nose of his ship between the flat angle that may create a stall and the steep angle that may mean a short landing.

The student skillfully opens up his engine for a moment every 500 feet, and at the same time holds down the nose of the ship to prevent a tell-tale barograph record which will disqualify him. This is a cold-weather dodge to insure a warm engine in case of a bad approach, and instant power.

The official observer notes the landing skill exhibited, and other demands having been met, and a successful barograph record made, the pupil gets his "license". These are present regulations for beginners.

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## Pilot Plans Recovery of Furs

ADVENTURERS used to go in search of excitement and loot to the South Seas and other warm countries, but William R. Graham, veteran pilot of the north, is planning to recover a million dollars worth of fur now lost on the Arctic Coast.

A Hudson Bay ship, cought last October in the Arctic Ocean off Point Barrow, from which the passengers were rescued but on which a valuable cargo of furs was left, is the goal set for by Graham.

He figures on picking them up in a new cabin monoplane that he has fitted up in Los Angeles with special oil requirements for the intense cold. Graham plans to change the landing gear to skids at Seattle and prepare to fight his way through snow and fog. The plane is equipped for the Arctic weather.

## New Spad Plane Breaks World 500 Km. Speed Record

**Front elevation of the Bleriot Speed marvel, with bottom overhang.**

A NEW world's speed record for a 500-kilometer closed course was hung up by the French aviator Massotte in June, when he reeled off the distance at the remarkable speed of 191.75 miles an hour.

The performance is all the more remarkable as it was made at the Villacoublay course, involving nine turns at a hundred and eighty degrees with a strong sidewind blowing at the time and considerable fog.

The machine used for this remarkable performance was a new Bleriot Spad of revolutionary design, built originally as a single-seat fighter for military purposes. A modification of the familiar Spad 91, it is called the "Spad 91-7", and represents the latest effort of French designers to gain extreme speed by reducing wing surface without sacrificing the maneuverability so necessary to a military machine.

In the Spad 91-7, a biplane scout of the ordinary type, the ailerons were placed on the lower wing which was itself brought very close to the ground to take advantage of the "air mattress" in obtaining a low landing speed. The ailerons gave such excellent results in this position, reducing wing area to gain more speed, that it was felt it would be undesirable to move them to the upper wing.

At the same time, to reduce the aileron surface would make the machine difficult to control. The question was solved by taking the surface away from the upper wing instead of the lower and as a result, the Spad 91-7 presents the extraordinary appearance of a sesquiplane turned upside down with the smaller wing on top.

The resulting reduction of wing surface amounts to forty square feet, giving the new 91-7 a surface of 194 square feet instead of the 236 square feet of the original Spad 91. This, with refinement of various details, such as reduction of the cockpit struts permitted by the reduced weight of the upper wing, has permitted an average speed gain for the new machine amounting to 32 miles per hour.

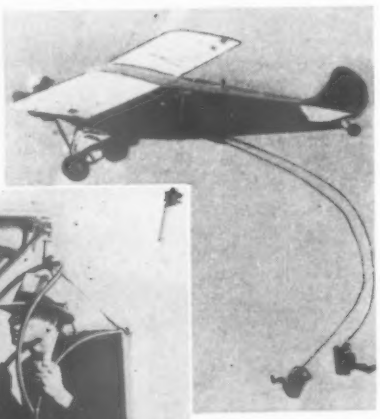
The leading characteristics of the new record-breaker are as follows:

Wing spread—upper wing, 22.9 feet.
Wing spread—lower wing—28.37 feet.
Length—29.66 feet.
Height—9.41 feet.
Total wing surface—193.76 square feet.
Maximum speed—203.68 miles per hour—fully loaded.

**Rear view of the Bleriot racer driven by a 500 h.p. Hispano-Suiza "W" or "X" engine. Power loading is 6.43 pounds per h.p.**

## Here, the Pilot Chucks Them Overboard

WHENEVER safety parachute devices have been proposed, the question arises whether the passenger can be depended upon to operate the various gadgets that release his parachute. The passenger is likely to get excited or even faint away in time of danger,



Above we see the pilot and passenger just after being thrown clear of the plane.

At the left will be seen the derrick-like appliances used for swinging them out of the ship.

and this of course renders the whole device useless.

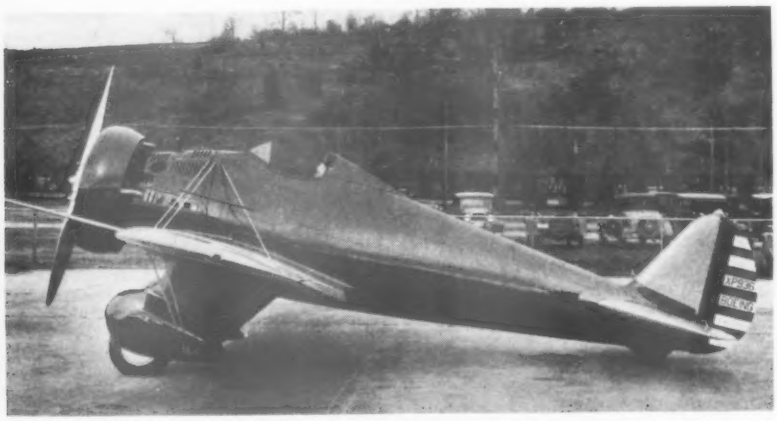
Spud Manning and Frank Austain, professional parachute jumpers, have devised apparatus which they claim will function under all conditions. By means of the slings shown here, the pilot can at any time throw the passengers and himself out of and clear of the ship.

The device has been tried out on a full size ship—with fair success and it is likely that this scheme may prove practicable.

## Another View of the Boeing XP-936

A NUMBER of our readers have asked for a side view of the Boeing XP-936 Army Air Corps monoplane. Evidently, they wish this view for model making purposes. Well, here it is, boys.

Because of the tremendous speed of this monoplane, the control surfaces are relatively much smaller than in the slower ships, and therefore it may not be possible to reproduce these parts exactly to scale in a flying scale model. It is likely that the controls on the model would have to be considerably larger in proportion to the rest of the job. Also note the encased tail wheel and the arrangement of the landing gear.



Straight side elevation of the Boeing pursuit job XP-936. Note the arrangement of the wing bracing stays.

## "Poki"—Parachutin' Pup

"POKI" is a seven-month old boarhound—the official mascot of one of Uncle Sam's air squadrons stationed in the Hawaiian Islands. Poki has visited all of the islands in the Hawaiian group and has visited them by air.

An occasional crash, a fire or a catchase meant nothing in Poki's young life for he had experienced dozens of each. Life was becoming monotonous for Poki and for him, it seemed, there was to be no relief. There wasn't any more fun in burying bones either.

But Poki's master had a trick up his sleeve. With the help of members of the squadron, a parachute taken from a night-flare, was fitted with a dog harness and an automatic release. Poki didn't know what it was all about when, for the first time in his life, the wicked harness was strapped on his back. He growled and rolled, but the harness stayed put. There was nothing he could do about it at all.

Poki's master called him and told him to jump into the cockpit of his plane. A whir, a roar and in a few minutes the plane, with its dog passenger and officer pilot, was soaring on high. After a few minutes, the lieutenant seized the pup.

"Hey!" thought Poki, "What's this?" He didn't have time to think any more for in an instant he was over the side dropping straight down to the ground a few hundred feet below. "A heck of a way to treat a pal", ruminated the animal, "I'm off that chap for life".

But within a few feet, the 'chute from the flare bellied out, stopped Poki's descent with a jerk and from that moment onward, he was happy.

A new experience had come to Poki. Life wasn't so monotonous after all. Today, he is the envy of all aviating dogs—he's the only one who makes a daily parachute descent!

## Women Cast Vote for Smoking on Planes

BECAUSE a questionnaire showed a majority of men, and women passengers as well, favored permission to smoke on its planes, United Air Lines has rescinded a non-smoking rule on its transport ships.

## Plane Travel Sets New Safety Record

FIGURES on planes flown in regular scheduled operations reveal these interesting facts:

A passenger may travel the equivalent of 1,000 times around the world on the average before being involved in a fatal accident.

Or, to put it in another way, if a passenger travels 1,000 miles a week by air he would travel for 481 years on the average before a fatal accident.

# Radio Beams Guide the Planes in Flight

*by* ALBION R. LA FARGE

Just how the commercial planes are enabled to fly in soupy weather by flying along radio lanes directed from stations at the ends of the airlane, and how communication is maintained between the ships and stations.

WHEN the first primitive man fastened sails to his crude boat, there were the usual crowd of well wishers and "can't be dones" on hand. He would be drowned, seized by a monster or stricken by fire from the Gods for his insolence!

He dared something new and was therefore deserving of ridicule and criticism for departing from an established custom. But his jumping eventually extended to steamships and trains, and finally aviation, which now bears the oft assigned burder of progress and pioneering.

To those associated with aviation over the development period the progress of this utility is unbelievable. Pipe dreams are now condensing to hard cold facts. Watch the traffic, both mail and passenger, at any large air terminal where good dollars are riding those air carriers to prove it.

We think back over a short span of twenty years when a few pioneering companies dared offer a low powered plane for the private owner or small operator. It was lauged at. Who had the money to buy one and who would? A visit to any field today will give another answer.

Then another pipe dream comes true — the airmail spans the country—smooth, efficient and on time. The airmail is here to stay and it is important enough to figure in governmental economies and supervision.

In its early days, the airmail was a crude system compared to the present organization. The pilot went as far as possible—sometimes making the trip and sometimes not—depending on weather and motor. When bad weather set in he sat down or went back. "Waiting on the weather" was a familiar phrase around the mail fields.

And so it seems that weather was and is yet to be the stumbling block of aviation—the bugaboo, the bad boy for transport aviation to chew on. Weather, good, bad, or indifferent. Good sunshine, tail winds and unlimited ceiling are to be balanced against the black sheep of rain, fog and low ceiling. And how these black sheep can combine to make soupy weather. The war is on, a specialized war of attack and defence with a general staff and with men behind the lines. Instruments, trained pilots, radio, beacons, motors and planes, each to play a part for the common cause of schedule flight.

TOP—This transport plane is flying along a radio "track" that guides it to its destination. IN CIRCLE—Pilot talking to the supervisor. LEFT CENTER—The supervisor directs the planes and provides them data from the weather maps. BOTTOM—The station transmitter.

In what way has progress been made thus far?

Early forms of navigating instruments gave broad readings. The altimeter read in thousands of feet, with its lowest division reading 200 feet. For the pilot flying low and partly blinded by poor visibility, it was not sufficiently accurate. The pilot needed an instrument giving a ten-foot reading or even a one-foot reading. Now, on the "dash" of modern planes is such instrument, an altimeter so accurate that it registers when raised from the ground to arm's height.

The old belief that a pilot's sense of balance and direction could be developed to certainty in blind flying has been dropped into the basket of discarded beliefs. The turn-and-bank indicator, the rate-of-climb-meter and the Sperry Horizon have convinced the pilots that our sense of balance is a false friend. Needless to say the work of improving still goes on.

Another complaint was made against the magnetic compass. In rough air, the magnetic compass with its pitching, tossing and swinging, made it difficult to check courses and headings. The Sperry Gyro Compass was then converted into aviation use. This type of compass, when set for the desired heading, neither pitched nor tossed, changing its reading only when the heading actually changed. In technical terms, it eliminated the "turning error."

Ability to pierce blinding weather came by way of radio. Flying through low or zero visibility, or riding over it, the pilot keeps his course on the radio beam. The beam described in this achievement acts like a beam of light from a searchlight. Starting from a created source, it can be directed and concentrated on the desired target.

A radio beam at Newark aimed at Washington, hits Washington and vice versa. Although narrow at its source, say some fifty feet, it broadens with distance, making it necessary for Washington to shoot another beam at Newark. These two beams overlap, producing a continuous beam, although the two divisions are transmitted at different frequencies to avoid interference.

For example, a pilot leaving Newark for Washington (Fig. 1) tunes in with his beam receiver. He tunes in the Newark beam, not yet near the overlap. When tuned, he is informed by signal where he is in relation to the beam course. A dot-dash—the "A" of International Morse—informs him he is to the right of the course. Should

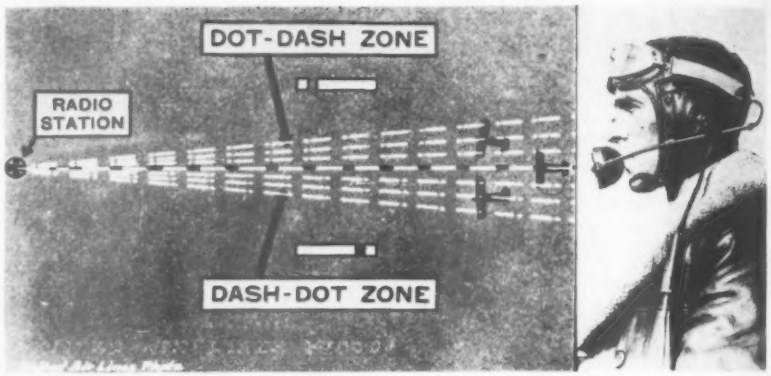
he be to the left, he receives a dash-dot—the "N" signal.

A series of dashes, caused by "A" and "N" meeting at the center of the course is the "on course" signal. These signals are interlaced with the identity of the transmitting station, also given in code letters as by an "H", "J", "W", etc. This signal is necessary where beams meet—such as at Washington. Proceeding along the Newark Beam until the overlap is reached, the pilot then tunes in the Washington Beam. This beam narrows as it nears Washington —"drawing in" as it is called.

This method of using overlapping beams eliminates the evil of beam broadening, overcoming the danger of the beam covering too much territory at the destination. The beam is allowed a broadening of from ten to fifteen miles before the overlap steps in.

Soon, this overlap and broadening will be eliminated as well as the "Skips" or points on the course where the beam leaves the true course and wanders around the country, eventually returning to the true course. "Skip" locations are known as they are constant and pilots continually using the beam grow accustomed to making allowance for these deviations.

Now, let's make an air mail reading of the beam. Let us continue on from Newark to Washington. The pilot tunes in the Newark Beam on leaving Newark. He receives an "A" signal. Desiring, on account of the weather to stick close to the true course, he must go to the left to catch the "on course"




Simple diagram of a radio beam showing how the ships can fly on their course by staying within the beam. If to the right they set the "dot-dash" signal, if too far to the left they receive the "dash-dot" note. Communication can also be carried out between station and pilot so long as the latter is within the beam.

course" from "A" or "N" zones is heralded by receiving the steady dashes of that position as an underbeat of the zone signal. When on course, any tendency to slide off results in receiving the "A" or "N" as an underbeat—becoming louder as the error in direction increases.

At the overlap, the Washington beam is tuned in and the zones are reversed, "A" for "N", or "N" for "A". This serves to identify the pilot's position. On the new beam the narrowing takes effect. The "drawing-in" has begun.

As the plane nears the Washington transmitting station, the slightest deviation from the "on course" cannot be made without receiving the signal of

This procedure reads so easy that we must slip in the inevitable joker. After arriving at the beam end, the pilot must find the landing field. In clear weather it is a simple matter, even in weather of poor visibility, as he knows the location of the field from the transmitting station signals. In weather of zero visibility, he has a job on his hands. Stations located to lay on the beam course make the job much easier. The "drawing-in" and "field finding" calls for experience and clear thinking.

I have known pilots to spend hours searching for the landing field after arriving at the beam end, waiting for a break to get down and losing it when the fog remains solid. Then back to

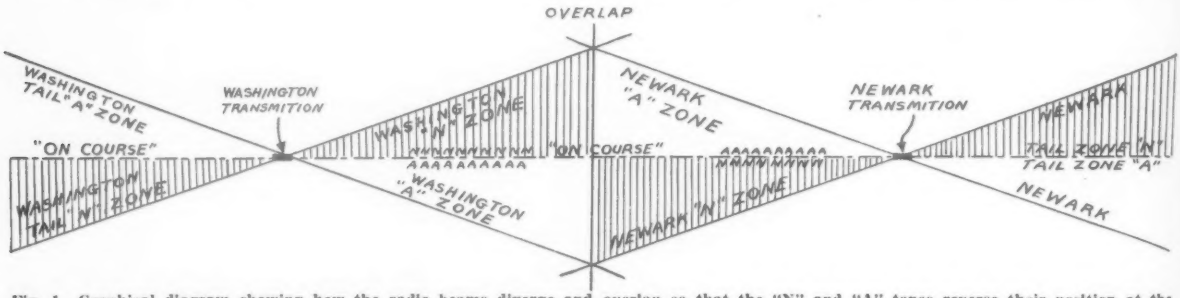



Fig. 1. Graphical diagram showing how the radio beams diverge and overlap so that the "N" and "A" tones reverse their position at the center of the line and at points beyond the stations. These points of reversal in the nature of the signal tell the pilot whether he is in the center of his run or whether he has passed either of the two terminal stations.

signal. An amateur turns sharply to the left, the experienced pilot slides over.

The angle of approach to "on course" is important. A sharp angle, one of 80 or 90 degrees across the beam, usually results in overrunning the "on course" signal and lands the pilot in the "N" zone. A like turn to the right brings him back into "A" zone. Thus, his course is somewhat like a corkscrew in appearance.

It has been noticed that the signals are weak on the outskirts of the beam. By listening to the volume of the signal, the pilot can determine his distance from the course center and governs his approach accordingly.

A gradual, flat angle approach does the trick. Once on course, only a slight change of heading is needed and he "rides the beam". Approach to "on the zone favored. Over the station all signals cease, for the beam is completed. Should the station be overun, the beam is again heard, this time as at Newark—"A" for the right side zone and "N" for the left.

This is why the original Washington beam was reversed. The searchlight has its reflector back of the source of light, but the radio—having none—shoots in both directions like the recoil of a gun. This back part is known as the "tail" of the beam.

As a pilot nears the beam transmitting station, a new note or beat is heard—somewhat like the sound of the propeller of a boat. This is the noise caused by the transmitting machinery and serves as a warning to the beam wise pilot that the end of the beam is being reached.

the beam at the transmitting station to make a fresh start. To land, the pilot must see. Obstacles such as telephone poles, buildings and trees are poor companions of an airplane in flight. When we have wide open fields, low surroundings and landing beams, this trouble will vanish.

The variation of the beam station signals from the landing field location is this. When the Department of Commerce installed the beams, they failed to take into account the zeal and aptitude of the pilots who were to use them. It was intended that the beam was to be used for "coming through" rather than for "coming in". The "coming through" expression is used for the following conditions.

(*Continued on page* 201)

# The Inside Story of the Caterpillar Club

*by* ROLLIN H. WAMPLER

An authority tells how this famous club originated, how to become a life member and how the first members joined it. Everyone can join it, but few favor the initiation.

NOTHING in the history of man's conquest of the air is more interesting than the development of the parachute, and in connection with parachuting are to be found some of the greatest tales of courage and thrilling adventure in all of man's history.

It must be explained that any person who saves his life by jumping from a disabled aircraft with a parachute automatically becomes a member of the Caterpillar Club. The club was founded at Dayton, Ohio, some years ago.

On October 20, 1922, Lieutenant Harold R. Harris, Chief of the McCook Field Flying Section, saved his life by jumping with a parachute from a monoplane. On November 11, 1922, Lieutenant Frank B. Tyndall made a similar jump and also landed safely.

Sometime between these two dates, three friends of aviation met in the Parachute Unit at McCook Field to discuss parachuting. They were Verne Timmerman, a photographer on the *Dayton Herald* staff; Maurice Hutton, aviation editor of the *Dayton Herald*, and M. H. St. Clair, a Government parachute engineer. These men discussed Lieutenant Harris' jump, which was receiving a great deal of publicity.

Timmerman suggested that a club be formed to embrace the names of airmen who saved their lives by jumping and several names for the club were offered. In a statement deposited in the archives of the War Department the surviving founder, St. Clair, tells how the club was finally named. It was through a picture advertising Caterpillar tractors that St. Clair received inspiration for a name. He says:

"I immediately got in touch with Timmerman and Hutton, and suggested to them that the organization be called 'Caterpillar Club' for several reasons, namely: The parachute main sail and lines were woven from the finest silk. The lowly silk worm or caterpillar spins a cocoon, crawls out and then flies away from certain death, which would occur if it remained in sight of the cocoon he has made."

THE Caterpillar Club has never had an official meeting nor elected officers. It functions solely as a name and as an influence. In a semi-official capacity, the United States Government undertakes to authenticate the claims of candidates to the Caterpillar Club and the Army Air Corps has maintained a complete roster of jumps within the borders of the United States.

There is often considerable dispute about membership in the Club, for no very definite rules have ever been made,

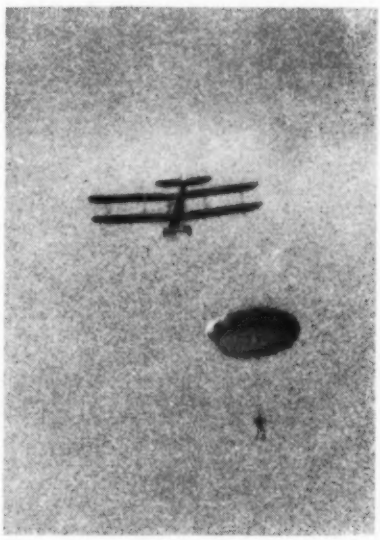


Chart showing the initiation ritual for membership in the Caterpillar Club.

and the Club is still in a more or less plastic state.

It is now believed that the first person in the United States to save himself by deserting a sinking aircraft was Henry Wacker, who jumped from the *Wingfoot Express* in 1919. John Boettner, pilot of the *Wingfoot Express*, saved his life by jumping from the flaming non-rigid blimp a moment after Wacker and so became Caterpillar No. 2. The names of these two men head the list of Caterpillars.

The story of the *Wingfoot Express* and of the jumps of these two men is one of bravery and of tragedy. In 1919 the Goodyear Rubber Company assembled in Chicago the *Wingfoot Express*, a blimp, for a goodwill tour over the middle west. The ship was 158 feet in length and 34 feet in diameter.

By July the blimp was ready for a trial, so about noon, July 21, the engines were primed and the controls adjusted. Pilot Boettner took his place in the prow of the ten-passenger gondola and he was followed by two mechanicians—Carl "Buck" Weaver and Henry Wacker. After two short and uneventful flights, the prejudices and fears of onlookers were quelled. For the third flight, two passengers stepped forward—Earl Davenport, publicity man for the White City Amusement Park, and Milton G. Norton, photographer for the *Chicago Herald and Examiner* newspaper in the city.

Boettner explained the use of the parachutes before taking off and the passengers jested about the strange contraptions. After an impressive takeoff the *Wingfoot Express* headed north to its tragic end.

FORTY-FIVE minutes after the takeoff, the rubber envelope cracked amidships as a sheet of flame surged over the stern. Fanned by the wind, due to the speed of the blimp, the flames roared over the gas bag.

The pilot was the first to grasp the situation. He half turned and shouted:

"Jump! That's the only chance you have!"

Wacker shouted frantically at Davenport and Norton, who were fumbling with their parachute harness.

Wacker jumped first from the port side. Boettner leaped from the pilot's seat. Weaver and Norton followed. Davenport remained imprisoned in the wreck by entanglements in his harness.

The blimp was now a mass of flames. As if determined to thwart efforts at escape, it plunged downward towards the four men whose parachutes had just blossomed forth. The demon ship overtook Weaver's parachute and set fire to it. In an instant the white umbrella was consumed. His body plunged earthward followed by the burnt stubs of shroud lines.

Pilot Boettner's parachute was fired, but he was able to put out the flame. Boettner and Wacker had jumped farthest from the flaming ship.

The *Wingfoot Express* hurtled downward straight towards the Illinois Trust and Sav...gs Bank Building. With unerring accuracy it plunged through the skylight and down the central well of the building into the lobby where 150 people worked. The gasoline tanks exploded. Instantly the interior was a roaring chimney of flames. Weaver's body plunged to the bank floor in the wake of the wreck. Ten of the bank's employees were killed. Many were also injured by the explosion and fire.

MEANWHILE Norton, unable to steer his life saver, crashed into a window in the Western Union Building and plunged to his death on the street below, unable to hang on to the ledge.

Wacker landed on La Salle Street and was taken to a hospital, while Boettner landed on a roof with minor injuries. He and Wacker are now living in Akron, Ohio, and are still connected with aviation.

Colonel Charles A. Lindbergh is perhaps the most famous member of the Caterpillar Club. Four times—twice in 1925 and twice in 1926—he leaped to safety from disabled airplanes.

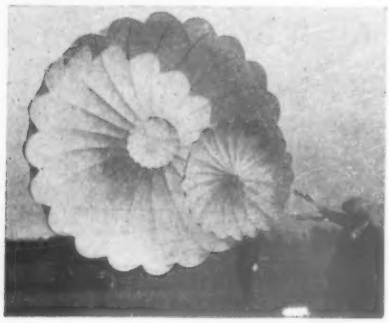
Lindbergh was a member of the class

of 1925 at Kelly Field. The only major accident of the class occurred nine days before graduation. Lindbergh had a part in this aerial drama.

On March 6, 1925, Cadet Lindbergh and Lieut. C. D. McAllister collided while taking part in aerial combat practice. The ships locked wings and began to spin towards the earth. Lindbergh and McAllister both jumped to safety. By this accident, both Lindbergh and McAllister became members of the Caterpillar Club.

SOON after graduation, Lindbergh became chief pilot for the commercial lines of the Robertson Aircraft Corporation. He was induced by an aeronautical engineer to test a newly developed commercial plane. On the first flight he attempted no difficult maneuvers, seeking merely to get the "feel" of the ship. On June 2 he took her up for final and exhaustive tests. He sent the ship through spinning nose dives, barrel rolls, loops, and many other maneuvers familiar to the airman. The ship performed beautifully.

There remained but one more test. That was the tail spin. After sending the ship through one-half revolution of a left spin and coming out safely, he ran her into a second left spin, allowing the ship to spin two complete turns. But this time the ship turned sharply



Trying it out on the ground for safety.

and the controls became useless. Lindbergh was unable to right the ship.

He realized that unless he jumped at an altitude of 300 feet or more his parachute would not function properly. In a moment he was out of the ship.

The Robertson Aircraft Corporation won the St. Louis-Chicago air mail contract. It was Lindbergh's job to keep the mail planes going on schedule time.

ON September 16, 1926, Lindbergh took off from Lambert Field, crossed the Mississippi River, and picked up mail at Springfield and Peoria. He left Peoria about dusk. Soon he found himself flying over a heavy fog. He turned back with the intention of dropping a flare and landing. The flare failed to function.

He again headed for Maywood, his next stop. He arrived over the Maywood Field just before seven o'clock, but he could not see the ground.

Lindbergh then headed south. After circling for some time, he headed west to be sure of clearing Lake Michigan and attempted to pick up a light on the Transcontinental. At 8:20 P. M., the engine stopped and he cut in the reserve tank. He decided to jump as soon as the reserve supply was exhausted. Unable to open the mail pit in order to throw out the mail, he began to climb for higher altitude.

The pilot now saw a light far below, so he glided to 1,200 feet and released a flare. The flare showed only solid fog. Again he began climbing for altitude. To continue in Lindbergh's own words:

"At 5,000 feet the engine sputtered and died. I stepped upon the cowling and out over the right side of the cockpit, pulling the rip-cord after about a 100-foot fall.

". . . I was falling head downward when the risers jerked me into an upright position and the chute opened. . . .

"I pulled the flashlight from my belt and was playing it down towards the top of the fog when I heard the plane's engine pick up. . . . I had neglected to cut the switches. Apparently, when the ship nosed down, an additional supply of gasoline drained into the carburetor.

"Soon, she swung into sight, about a quarter of a mile away and headed in the general direction of my parachute. I put the flashlight in the pocket of my flying suit preparatory to slipping the parachute out of the way if necessary.

"The plane was making a left spiral of about a mile in diameter and passed approximately 300 yards from my 'chute, leaving me on the outside of the circle.

"I WAS undecided whether the plane or I was descending more rapidly. I glided my 'chute away from the spiral as rapidly as I could. The ship passed completely out of sight, but reappeared in a few seconds, its rate of descent about the same as that of the parachute. I counted five spirals, each one a little farther away than the last, before reaching the top of the fog bank.

"When I settled into the fog, I knew the ground was within 1,000 feet. I reached for my flashlight.

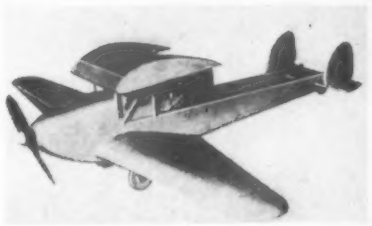
"I could see neither fog nor stars and had no idea what kind of territory was below. I crossed my legs to keep from straddling a branch or wire, guarded my face with my hands—and waited.

"Presently, I saw an outline of the ground, and a moment later was down in a corn field. The corn was over my head and the 'chute was lying on top of the stalks. I hurriedly packed it and started down a corn row. In a few minutes I came to a stubble field and some wagon tracks which I followed to the farmyard a quarter mile away."

Lindbergh's fourth Caterpillar jump was made under very similar circumstances. This time he jumped from 13,000 feet at night, thus establishing a record for night jumping.

END

## Cabin Carried by 'Chute



The cabin slides toward the tail on the two rails.

THE French government is carrying out experiments with parachute safety devices much like those proposed by our own government some time ago.

Like our own officials, the French consider it more practicable to lower a detachable passenger cabin by a parachute than to lower the whole airplane by this method.

The invention shown here, in which models are used for demonstrating the scheme, covers a separate and detachable cabin which is lifted from the body of the airplane at the will of the pilot.

The pilot pulls a lever which allows the cabin to slide to the rear end of the fuselage, passengers, mail, pilots and all. At the end of the trail, the parachute opens and the descent begins.

Here the cabin is just being picked off at the rear by the parachute.

## Troops by Airplane

THE British Government in Egypt uses huge Vickers-Napier troop planes experimentally for moving soldiers. The first experiment saw a sizable squad flown to Cairo in bumpy weather.

The plane made a perfect landing, but no soldiers poured out. Finally, a man pushed open the cabin door and fell out. He was slowly followed by the rest of the detachment, which collapsed on the ground—man by man.

These troops had not been accustomed to plane transport and acquired severe air-sickness.

Two or three months ago, it was necessary to send troops from Egypt to Cyprus by air in these great planes, and the voyage was made perfectly.

# Rider's Super-Speed Racing Lightplane

*by* H. R. REYNOLDS

Full details on the method of getting the most speed from a limited amount of power, in the 350 Kgm. Class.

GETTING the maximum speed out of the smallest planes probably has never been better demonstrated than by Keith Rider, a San Francisco aeronautical engineer. He established a new world's record for land airplanes of the 350 Kgm. class this spring with his "San Francisco II" over a three-kilometer straightaway course at Santa Maria, California.

On May 11, this tiny low-wing monoplane with retractable landing gear was flown at Santa Maria by Robert Clampett with Joe Nikrent, official timer of the N. A. A., who clocked it at an average speed of 199.73 m.p.h. This bettered the former mark of 186.4 m.p.h. held by a Tiger Moth.

This speed was made without the diving start allowed by N. A. A. rules and Rider believes that with a power dive over the starting lines it will set a mark of nearly 240 miles per hour. In the trial at Santa Maria, he had Clampett forego the diving start because he wished to ascertain the top speed of the ship in normal level flight.

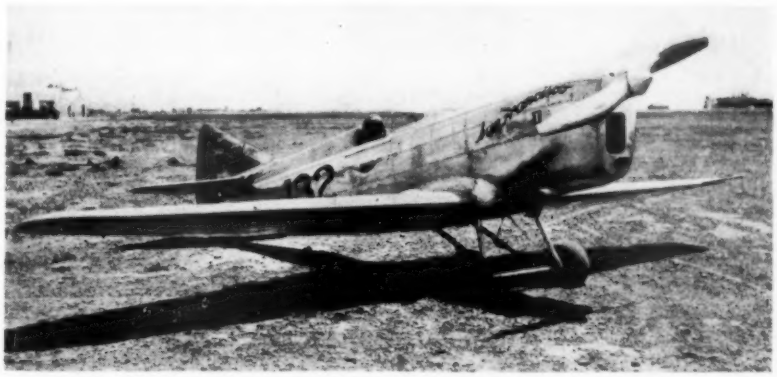
The San Francisco II was completed for racing, just in time to enter one of the last events of the National Air races at Cleveland, last September. Piloted by Roy Moore, it won the contest over a five-mile triangular course from a standing start, averaging 156 miles per hour.

In this race, the retractable landing gear was not yet in working order. Several days later, the plane was entered in the Fiesta meet at Los Angeles, where it crossed the finish line first in the three races in which it was flown in stiff competition.

Rider then worked out more detailed streamlining on the ship, and after the record hop in Santa Maria, shipped it to Omaha where Clampett flew it at an average speed of 176.06 miles per hour to win the feature event of the annual races there. On straightaway dashes between pylons Clampett traveled more than 200 miles per hour.

The San Francisco II is powered with a Menasco inverted four-cylinder engine "suped up" from 95 to 180 horsepower. Its duralumin fuselage is only 17 feet long and the wingspread is 20 feet, 6 inches. Wing and tail surfaces are of plywood covered with linen, the assembly being sanded down and liberally coated with aluminum lacquer. This gave them a metallic smoothness.

Only ten inches longer and powered with a six-cylinder 270 h.p. Menasco, but otherwise of the same dimensions, is Rider's San Francisco I, which ran second to the Gee-Bee Super-sporster in the 1000 cubic inch free-for-all race at the last National Air races. Rider now is grooming this larger speedster for an assault upon the unqualified world's record for land airplanes. He expects this ship to approximate 300 m.p.h.



An exceedingly clean cut job, even for a racing lightplane. Note the narrowness of the fuselage and the heavy filleting near the body at the wing roots.

Close adherence to the laws of aerodynamics is the keynote of Rider's work in getting the maximum speed for a plane's size. All parts of his specially built ships are modified and streamlined so that the planes are not merely bulky masses drawn through the air by sheer power.

The racer in flight with the wheels retracted. There is very little parasitic resistance in evidence here.

In aiming at speed, Rider's general rules call first for the selection of a motor with the greatest power for its frontal area and weight. The fuselage is then designed around the chosen engine. Cantilever wings are used to do away with external bracing. The landing gear is made retractable. Every effort is made to eliminate useless weight. The San Francisco II, without pilot or fuel, weighs only 770 pounds.

A large opening in the nose of the fuselage admits air which is deflected evenly about the cylinders by a duralumin apron, often the custom with in-line air-cooled engines. Because of the high acceleration, the gas is fed under pressure in Rider's ships.

One of the most important features in both the San Francisco ships is Rider's use of statically balanced ailerons that will not flutter at tremendous speeds. It was the loss of an aileron through flutter, Rider believes, that caused the death of Lowell Bayles in the Geebee sportster.

Getting all the speed possible out of a plane naturally calls for some sacrifice, chiefly in the safety and the comfort of the pilot, and tiny racers are no exception to this rule. The stalling and landing speeds of Rider's creations, as in all super-speed jobs, are unavoidably high. There is barely room for the pilot's body in the cockpit of either plane.

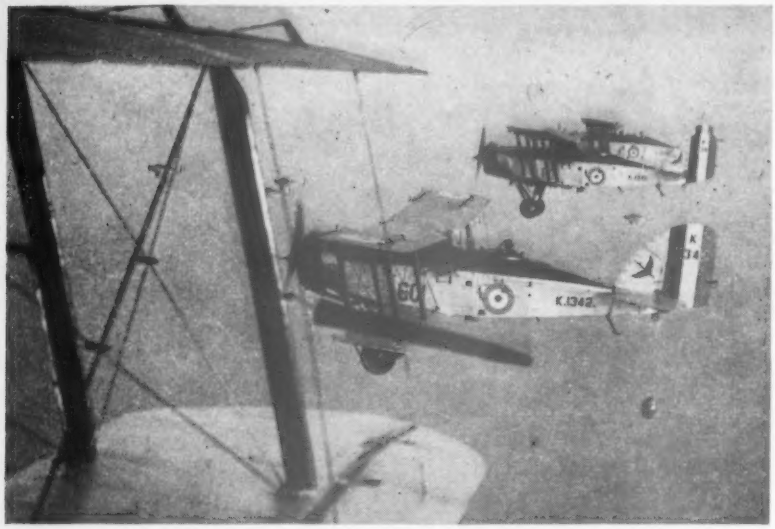
Motor installation is exceptionally tight and a difficulty of no little magnitude in designing his ships was encountered by Rider in finding room in the fuselage for the landing gear when it was retracted.

This reminds one of the "form-fitting" light racing plane built by Howard that created such a sensation at the Chicago races and elsewhere. In this little ship, the designer literally fitted the cross-section of the fuselage around his body so that there was not a square inch of surplus presented area.

By the use of an inverted engine, with its cylinders out of the air-stream, the reduction of front-end resistance is particularly marked. However, there still remains the frontal area of the air-intake-port which will ultimately be abolished.

END

## British Planes in Formation Flight



British Warplane formation at the recent Pageant.

IMAGINE yourself in the cockpit of one of these British planes in formation flight. The wing of your own ship is in the left foreground while the three ships to the right, sighted along their tails, are in exact alignment.

This inspiring sight was had by all of the participants in the Royal Air Force Pageant recently held in England where aerial maneuvers of all kinds were demonstrated to the public.

These ships are truly British in design with their pronounced dihedral angle and biplane wing settings, as well as the typical box-type fuselage.

## Our Photo Phans Club and Its New Members

BUSINESS in the Photo Phans Club is fairly good. Not as many letters have been received as during past months. Is this for the reason that we have enrolled all of the members that are interested in this phase of aviation, or is the slump due to the summer vacation period? That's what we would like to know.

* * *

JACK DIEMAS, 123 E. Center St., Pomona, Calif., is collecting photos of Boeing fighters and new types of monoplanes. He can trade snap-shots of Curtiss and Keystone bombers.

Homer S. Reisinger, 4296 W. 21st St., Cleveland, Ohio, has over 300 photos of different kinds of planes, including pictures of the National Air Races, 1931, and photos of blimps taken at the balloon races of 1930. He will sell photos at 10 cents each. Size, 2½x4¼ inches.

Marion Heyward, 1021 Vineville Ave., Macon, Georgia, has some wartime plane photos to swap for modern military plane photos, and would prefer pictures of modern pursuit jobs. He will also build models in exchange for photos, or will buy, build or exchange models with wing spreads up to 3 feet 6 inches.

H. Matthews, 1844 Grace St., Chicago, Ill., has just started a photograph album of war planes and also modern planes. In reply to his query, we believe that he refers to the publication called the "Air Corps News Letter", published for the officers of the U. S. Army Air Corps.

Robert Benedict, 1929 Flushing Road, Flint, Mich., says that he has no pictures that he wishes to trade, but that he will buy any kind of airplane pictures (preferably World War planes) reasonably priced.

Gerald D. Cord, 118 N. Orange St., Glendale, Calif., would like photos of all sorts of planes, preferably World War planes. He has quite a nice collection of German Official Photographs, among which are such types as the Pfalz triplane, Pfalz D-3 and many other rare German types. His pet photo is a Friedrichshafen pursuit ship. And Mr. Cord would like to receive letters from faraway places, especially England, Cuba, Australia, etc. Mebbe some of our foreign readers will oblige him.

Harold G. Martin, 3664 Park Ave., Bronx, N. Y. C., has about 250 photos that he wishes to sell. He will also consider swapping. We thank you for the photos that you enclosed with your letter. They are quite interesting.

Bob Bough, 360 S. Midler Ave., Syracuse, N. Y., has a very large collection of pictures. His most treasured picture is of Quentin Roosevelt taken just after he was shot down.

## New Starter for Air Corps

A NEW type of inertia starter has been developed by the Army Air corps material division at Wright Field. It is the standard inertia starter with a booster magneto incorporated in the drive in such a manner as to mesh the booster with the starter gears at the same instant the starter is engaged with the engine.

The total weight of the new equipment is 30 pounds. The necessity for a separate booster magneto and control is eliminated, thus saving ten pounds over the type B-11 which is standard at present. The new starter has the further advantage of freeing the hand of the pilot, formerly used on the booster, for the operation of the throttle and the wabble pump.

## A Remarkable Snapshot

GREAT presence of mind on part of the photographer gives us this unusual view of a plane just before crashing. It was taken at the Agua Caliente, Cal., golf links when Noel Sharp, pilot, and R. E. Evans met with an accident that wrecked the plane but in which they received only minor injuries.

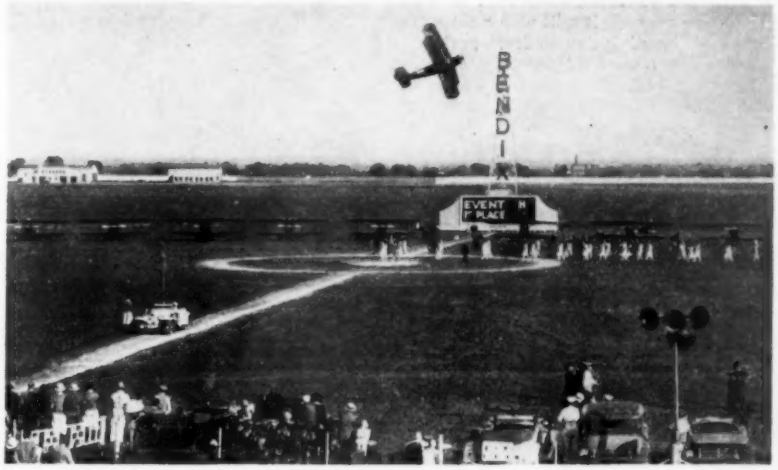
Close examination of the picture shows that the left aileron is missing, and this was probably the cause of the accident although the pilot claims that his engine was misfiring at the time because it was not thoroughly warmed up before the take-off. Whatever the cause, the camera shows one aileron missing.

Photo of this spinning plane just before it reached earth. Note that the left aileron is missing.

# Locating and Building a Small Airport

*by* STUART E. HALLIDAY

Mr. Halliday's article solves many of the difficulties experienced in constructing a small airport so that it will meet with the approval of the Department of Commerce. Preparation of a suitable field, its location, drainage and illumination are all explained.



A sporting event in progress at a well layed out flying field and airport. The pylons mark the legs of the course.

ANYONE who goes to an airport on a busy day—especially during these summer months—and notices the unusual activity taking place, invariably gives some thought to the physical aspect of the air field and its equipment.

What had to be done to the ground to insure a safe landing surface? Why are the runways laid out in such fashion and what material is used to construct them? Has the field a drainage system? How was it installed? Why are there different colors shown by the boundary lights?

These, and a host of other questions, have been asked by people who realize that an airport is not just a bare field on which hangars have been constructed, but is a carefully engineered project where skill and intelligent planning have played a great part.

Way back, when barnstormers were the publicity agents of the aircraft field, they flew from town to town, offering rides at "so much a head". Naturally, they did not expect anything better than a level pasture ground for a landing field and, from the statistics we now have, they did remarkably well insofar as accidents were concerned.

With the advent of mail lines—passenger lines—aero clubs—schools and sportsmen pilots, however, cities and towns suddenly found themselves thinking seriously of a tract of ground that could be developed into a safe, convenient and accommodating airport. Uncle Sam, too, saw the need for weather service stations and a regulatory hand in airport building operations.

As a result, the construction and design of airports has become a highly important factor in the industry's business scope and one to which many cities have given their full-hearted support.

The site of the airport is a very important consideration in the preliminary planning. Not only must convenience and accessibility to the city be given thought, but the proposed location must be away from land subjected to overflow. It should have a minimum of obstructions surrounding it and so planned that prevailing head-winds can be used to the best advantage. Character of the soil, absence of factory and railroad smoke (and fog) are also important elements to a logical air site.

It might surprise many readers to know that the elevation above sea level affects the physical size of the field. For example, if a normal take-off at Mitchell Field, N. Y., is 500 feet, then the length required at Cheyenne, Wyo. (6,200 feet elevation), would be approximately 900 feet.

After the site has finally been agreed upon, the actual "building operations" begin. In the majority of cases, the land must be graded, leveled and faced with whatever type of sod has been decided upon. Although it is not absolutely necessary that a field have a sod surface, experience has proven that grass is an excellent material for absorbing surplus water and binding the soil into a firmer surface.

For new sodding in the southern states, bluegrass is mixed with Bermuda grass and redtop seed, the mixture being as follows: 25 to 30 pounds of Bermuda and 100 to 150 pounds of mixed Kentucky bluegrass and redtop to one acre. In the north, an 80 percent. mixture of bluegrass to a 20 percent. mixture of redtop will give satisfactory results.

Naming the type of seeding for each part of the country is an endless task, as each locality will experience its own individual problems, because of the character of the soil and various weather conditions. Whatever the problem, sod will prove to be the most practical of all surfaces and will afford a much more comfortable landing because of its advantages in resilience.

The Airport Rating Regulations of the Department of Commerce specify that "the landing area shall be approximately level and free from obstructions or depressions presenting hazards in the taking-off or landing of aircraft". Also, "The maximum slope of the landing area shall at no point exceed 3 inches in 10 feet, which corresponds to a grade of 2½ percent. in any direction".

If the soil is a very open sand or gravel—the type that will rapidly absorb moisture and rainfall—an almost level grade might prove to be the most desirable. If, however, the soil is too "tight" and the surface water must be removed through artificial means, grading is sometimes tried in order that any surplus water might run off.

A balance must be struck between these two extremes, because if the grade is too steep, erosion or washouts will result. A recent survey states that a grade of about 1 percent. under average conditions will be found to satisfy requirements. And, although grades of 2½ percent. are in use, they increase the difficulty of take-offs and landings.

It is often necessary to "fill" airport sites. This operation is usually conducted when the field is in a low area and there is danger of outside water draining into it. Hydraulic fills —that is, material obtained from pumping the bottoms of rivers or bodies of water—are the type most commonly used. It sometimes happens that these may require a very long period of time to attain sufficient firmness to serve as a landing base.

In some cases, these fills are placed in the field temporarily and utilized as a subbase for a harder surface. Thin layers are usually applied, each one being firmly rolled with tamping rollers. Strange as it may seem, it has been found more economical in some instances to design the necessary drainage system for a low-level field, than to try and raise its elevation by filling.

Many engineers have stated that the

science of air terminal draining is one of the most important to a well-designed airport. Artificial drainage systems are proposed to remove surface water, intercept seepage and stabilize the ground through the lowering of ground water level. Where low temperatures prevail, it will also reduce the extent of heaving due to frost action.

The importance of selecting a naturally drained site can be illustrated from the fact that drainage costs at some airports have run as high as $200,000.00 and, in other cases, from $300.00 to $400.00 an acre. The amount of study and research necessary to construct an adequate drainage system is enormous.

In some airports, the soil is of such nature that drainage does no good whatsoever. If, for example, the soil is a non-penetrable clay and one that will not suffer erosion in case of grading because of its well-knit peculiarity, drains would help but little. In a base of this kind, ground water (gravitational moisture) scarcely exists and the best means of keeping it safe for craft during wet weather is to spread granular material on the surface to reduce the muckiness characteristic of clay.

The term "penetrable" means the type of soil that will permit moisture to seep through it and, in so doing, to reach the tiling and pipe arrangement

**Two classes of drainage systems, the natural and herringbone layouts.**

of a drainage system. The uniform penetrable soil would probably not require any drainage. The uniformly impenetrable soil will not aid a drain in performing its functions and can be better handled by grading.

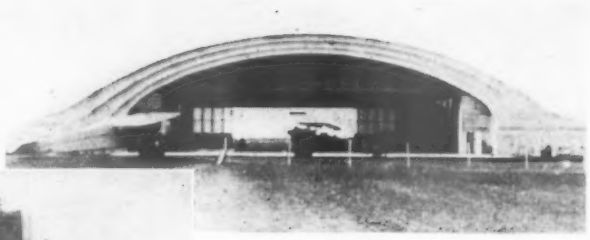
Penetrability above but not below requires subdrains placed just above the layer of ground that is impenetrable or, if the strate of penetrable ground has a great depth, the system would be placed only as deep as is necessary. Impenetrable soil above with penetrable soil below would probably be used without pipe or tile. The trenches would be cut through the impenetrable layer and filled with a porous or granular material such as crushed rock or gravel.

Tile is used as the basic means of transmitting water to carrying pipes. The pipes deliver their loads to inlets which in turn, pass the water to pipes that carry it to any designated point. The cost of a drainage system can be seen to be justifiable when one realizes that the working parts have to be installed out of sight, below the sod surface, and yet capable of bearing any load placed upon it by airplanes.

Many people have wondered why some airports have special runways, while others have not seen fit to go

**At the Right is the beautiful steel-concrete hangar at "Sky Harbor," Glencoe, Ill.**

**Below is the modernistic administration building at "Sky-Harbor" which also provides rooms for club activities.**



to the expense involved in creating them. Although they are not an imperative necessity, runways afford the best taking-off surface to airliners that must keep to schedule regardless of weather conditions. The following air fields, situated at various points throughout the country, illustrate the type of runways in use:

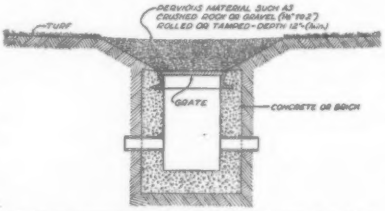
Floyd Bennett Field, New York City: Two concrete runways, 4,000 by 100 feet and 3,110 by 100 feet. Field is sod with natural drainage.

Detroit, Michigan: Four asphalt and concrete runways, 5,000 feet, 4,125 feet, 2,285 feet and 1,000 feet—all 100 feet wide. This field has both tile and natural drainage.

Chicago, Illinois: Four cinder runways. The field is composed of sod and cinders, both naturally and artificially drained.

Lincoln, Nebraska: Two oiled runways, each 2,000 by 100 feet. Entire field is sod and naturally drained.

Los Angeles, California: Two macadam runways, 2,100 feet long by 200




**Main drainage duct of approved construction.**

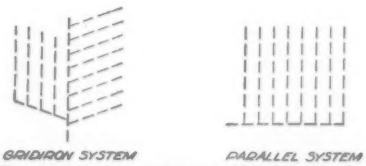
feet wide and 1,500 feet by 300 feet wide. The field uses tile drainage throughout, having an adobe surface. (Adobe is a light clay.)

Cinders, slag, concrete, macadam and oyster shells are generally used to build runways. It might also be noted that some airports have paid particular attention to constructing a well-drained runway system, composed of any number of lanes, instead of attempting to install a complete field drainage system with no prepared runways.

In the former case, ships are always able to arrive at and leave the airport, schedules are kept and the cost is appreciably smaller than when attempting to use the entire field which will make an elaborate drainage system necessary. Prepared runways, combined with a well-planned drain for the remainder of the field, compose the ideal airport for all weather conditions.

Thus far, many of those responsible for the development of airport landing areas have demanded that runways be so constructed as to offer a resilient and pliable surface so as to reduce impact of landing planes and be soft enough to make the use of tail skids effective. At the same time, they have endeavored to obtain a surface that would be durable, offer low tractive resistance and not be damaged by tail skids.

This is a large order and, to date, no




**The two systems recommended by the Department of Commerce for conditions in text.**

single type of pavement has had all of these advantages. Experimentation is being carried on extensively because landing a plane not equipped with brakes on a hard-surfaced runway is a difficult and, sometimes, dangerous operation.

It will be interesting to note that runways composed of granular or porous material (not held together by any cementlike composition) are harmful to the plane and its propeller because the latter is continually picking up particles of this material, with consequent damage to the ship. The fuselage, wing and tail surfaces and the propeller receive the greatest amount of abuse.

Those readers who live near a field equipped with concrete runways might pay particular attention to the surface of the cement and notice the manner in which it has been roughened to eliminate any skidding or sliding during wet weather. Using a rough broom on the setting concrete is one method of securing the desired surface.

Leaving the subject of runways, we come to another important air terminal consideration — the lighting system.

(*Continued on page* 199)

# France Presents a Snappy Tailless Lightplane

*by* FLETCHER PRATT

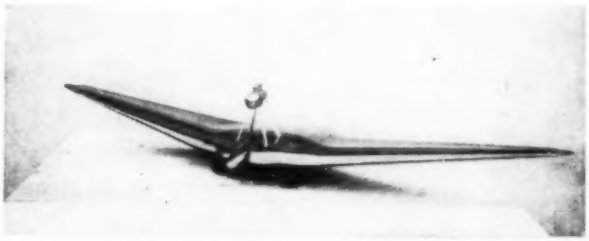
**A highly original design of tailless lightplane has recently been developed by Louis Guerchais, a French aeronautical engineer. It has awakened much interest in European aviation circles.**

(*See Front Cover*)

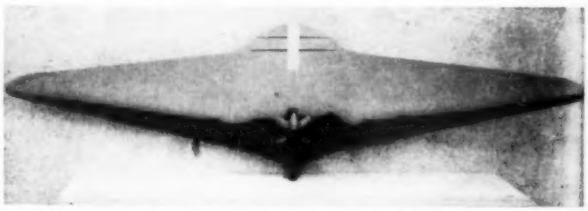
ONE of the most interesting airplanes produced this year is the new Guerchais tailless design, coming from the shops which have already intrigued the aeronautical industry by the production of a remarkable stratospheric airplane. The Guerchais tailless is built on the flying-wing principle under the Fauvel patents, but contains various modifications introduced by the designer—Louis Guerchais.

With a motor of only 20 horsepower and a total surface of 215 square feet, the remarkable little ship attains an air-speed of 80 m.p.h. According to the designers, it is incapable of going into a tail spin. It possesses a minimum speed of 25 m.p.h., which, with its diminutive size, makes it peculiarly suitable for the sportsman and amateur flyer who have only small landing spaces available.

The total weight of the new Guerchais, without the pilot, is 625 pounds, a practical demonstration of how far the weight-saving process has been carried. It is built of wood throughout and is carefully streamlined, the two wheels of the landing-gear being retractable and are provided with thin veneer panels which automatically slide into position to perfect the under-surface of the machine when the landing gear is retracted.



Three-quarter view of the Fuerchais tailless plane taken from the front. Note that the engine is carried in a nacelle well elevated above the wings.



Looking down on the tailless plane, a plan view in which the deeply tapered wings and the peculiar stumpy elevator can be seen; the latter forming a part of the rear wing edge.

Front elevation of the Guerchais ship in which the parasitic resistance has been reduced practically to nothing. It is a very near approach to the "flying wing" type except for the small streamlined engine nacelle.

The single seat is placed well forward and is entered through a manhole-like device, reminiscent of the arrangement on the stratospheric plane. When locked in position, it makes the cabin practically air-tight, a decided advantage in a machine which will attain a ceiling of over 17,000 feet. The cabin is enclosed on all sides by Triplex glass, and thanks to its position, gives the pilot an exceptional arc of vision.

The motor, a 20-horsepower Goiot, is mounted on four struts above and behind the cabin, the struts themselves carrying oil and gasoline lines. Oil storage is directly behind the pilot's seat; with gasoline storage in the wings.

The control surfaces consist of an elevator located on the rudimentary tail. This consists of approximately fourteen square feet of control surface. There are two tiny ailerons, placed at the leading edge of the wings which resemble the wing-slots used on the Handley-Page and other machines. Together they comprise only 6 square feet of surface.

From wing-tip to wing-tip, the new Guerchais measures 33 feet, with a total length of eleven and a half feet. It stands six feet three inches above the ground exclusive of the motor. According to the inventor, it will be capable of landing practically on a pocket-handkerchief, and possesses such extraordinary aeronautical qualities that it can meet any kind of air conditions without the pilot touching the controls. Its endurance depends upon the size of the gasoline reservoirs, for which there is ample room in the thick wings. The new machine is now receiving its tests at Villacoublay.

It will be noted, in common with other tailless planes, that there is a considerable amount of sweep-back in the leading edge of the wings. As a result, the mean effective center of pressure and the center of area are so far back that they act as rear stabilizers.

In this attempt at using the main wing surface for the dual purpose of lifting and stabilizing, the aspect ratio has necessarily been greatly reduced. This apparently reduces the effectiveness of the wings and does not speak for an exceptional performance in the way of loading her horsepower.

The placement of the ailerons on the leading edge of the wings instead of the trailing edge is quite unusual. It would seem that the canard idea has crept into the design to this extent at least.

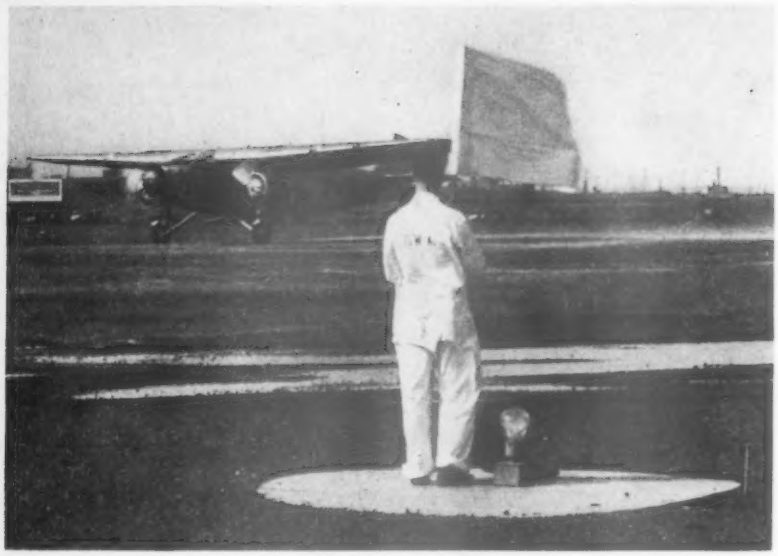
By the elimination of the long fuselage, much weight, labor and expense are saved, and besides, the length is so reduced that it should be easy to store in a small building. This, of course, makes an appeal to the amateur aviator of limited means. Then comes the matter of fore-and-aft stability which should be greatly improved since the inertia or "flywheelage" is much reduced in a longitudinal direction.

As will be seen, the deep wing section employed envelopes most of the fuselage, so that with the exception of the wheels and engine nacelle, very little fuselage is presented to the windstream. With a still thicker wing section, greater span and chord, it would be possible to carry all of the load within the wings. Retractable, wheels—fully retractable by the way, have still further reduced the air resistance.

It has always seemed that the retractable wheel problem on lightplanes could be greatly simplified by adopting a single mono-wheel in the center of the fuselage or wings, well provided with streamline pants. Then, on either side of the body, say out about half the wingspread, two retractable wing skids or wheels could be used, to hold the wings level while standing, and which could be withdrawn into the wings when in flight.

Instead of a fuselage, it is suggested that a wide center wing section, could be employed similar to that shown here but a considerably deeper section than has been employed by Guerchais.

# A Hot Exchange of Correspondence



"Pilots can, if necessity arises, refuse to take an overloaded ship off the ground without any fear that they will lose their position or be censured by their company."

IN ORDER to avoid personalities in this interesting controversy, we have designated the writer as Mr. "X". Mr. "X", the aviation manager of a large oil company, declares that Purcell's article in the July issue is "vicious, destructive and unfair."

**SUBJECT: Your July Issue Article, by Capt. Chas. W. Purcell**

Dear Sir:

The writer is transport pilot No. ***, and was a pilot during the World War. The above mentioned article by Captain Purcell is, in my opinion, a very vicious, destructive and unfair article. Facts have been distorted in a manner to lead the reader to the belief that airlines are operated in a manner highly inefficient, and that the Department of Commerce as an organization is composed of individuals seeking personal gain at the expense of individuals in the flying business. Specifically, and starting with the beginning of Captain Purcell's article, the writer wishes to point out certain discrepancies. It is my good fortune, as Manager of the Aviation Department of this Company, to come in contact very closely with airlines. Their method of operation is known, and any statements made by me can be substantiated.

1. Pilots do not rush into operation offices looking for weather reports. They are handed to them prior to their departure with the plane.

2. Airlines operating inter-state under Department of Commerce certificate of operation do not knowingly load their ships beyond the Department of Commerce allowable load.

3. Pilots can, if necessity arises, refuse to take an overloaded ship off the ground without any fear that they will lose their position or be censured by their company. No reputable airline will deliberately overload its planes under any circumstances, and by reputable companies the writer means Transcontinental and Western Air Inc., United Airlines, Western Air Express and American Airways, the operations of which he is particularly informed of since they are situated within our State.

4. While it is true that the pilot would be severely censured by the Department of Commerce for flying an overloaded ship, Captain Purcell does not go further and state that the airline would also have its certificate of operation cancelled, and would have severe penalties inflicted on it as well.

5. There is yet to be known a case of record, where any airline executive or radio operator has caused a pilot to proceed through weather which in the pilot's opinion was dangerous.

6. The innuendo about the low wing airplane which had an A. T. C., and which was later grounded, may be facts, but what would Captain Purcell have the Department of Commerce do if it found after issuing an A. T. C. to any airplane manufacturer in all good faith, and after all tests had been properly made and passed, and it was later determined that the ship was unsafe? Would Captain Purcell feel that the plane should be allowed to fly, with the possibility of killing pilots and passengers, or would the prudent thing be done, which is to ground it? The writer feels that grounding the ships is far the best thing to do. To err is human.

The writer well remembers the days of the OX-Jennys and how we, as youngsters with little or no knowledge of the maintenance of our planes and motors, and less than no knowledge as to the strain which we might place upon the ship without endangering or causing a structural failure, flew them, looped them, rolled them, spun them, and did other foolish things, killing some of our best pilots and many passengers. Those were the days when there was no supervision. Contrast those days with today when, whether we want to or not, we are forced, and justly so, to keep our ships in first class, safe flying condition.

It would seem to me that Captain Purcell is a destructive critic, without one bit of constructive thought in his mind, if he has one. It would be a distinct pleasure to meet and attempt to talk with Captain Purcell, because I think that his knowledge of aviation is probably limited to the reading of books or fairy tales, or perhaps he is one who has been grounded by the Department of Commerce for some asinine stunt.

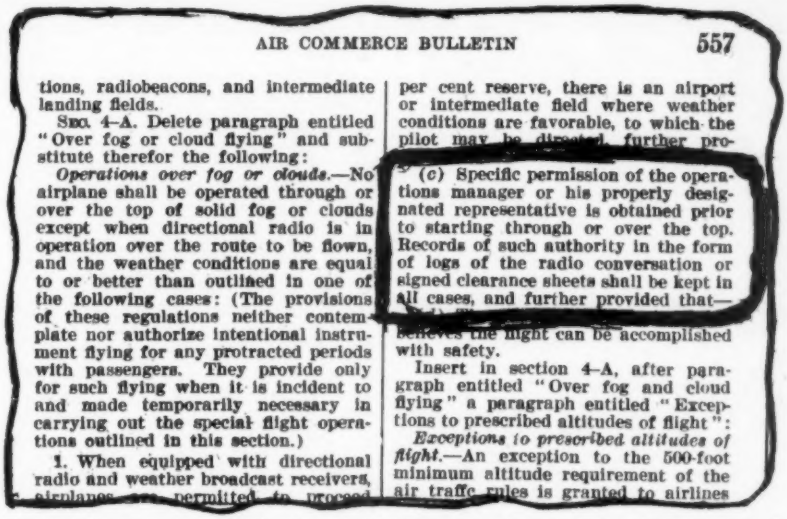
The greatest good that has been done for aviation has been the inauguration of the laws governing flying, and the enforcement of those laws by the Department of Commerce. The inspectors may, in some isolated cases, have erred in their judgment. What organization of similar magnitude with as many individuals in it has not? But for Captain Purcell or any other individual to take the stand that he has with reference to the Department of Commerce and its activities is, in my opinion, utterly idiotic and based on anything except facts.

It is not known by this writer whether or not this article was really written to be read, or is like another highly inflammatory article recently written in a magazine entitled "Death by Air Transport," or whether it was written for controversial purposes in the hope that you would get answers to it, such as being given you now. Your magazine in the past has been a very excellent one and free from such stories. It will be a pleasure to have an answer to this letter, and either yourself or Captain Purcell attempt to refute the truth of the statements which I have made herein. Needless to say, Captain Purcell's knowledge of factors in air transportation is less than nil, and his treatment of the Department of Commerce is worthy of his indictment and incarceration in some institution where he can do no further harm. If similar articles are to appear in your magazine, kindly cancel my subscription immediately.

Very truly yours, Mr. "X."

# Between Chas. W. Purcell and Mr. "X"

PURCELL, the author of the controversial article in the July issue, warmly defends his article and stages a comeback in his characteristic manner. "You can dunk your doughnuts in this little statement," cries Chas. W., and then proceeds to give examples.



AIR COMMERCE BULLETIN 557

tions, radiobeacons, and intermediate landing fields.

SEC. 4–A. Delete paragraph entitled "Over fog or cloud flying" and substitute therefor the following:

*Operations over fog or clouds.*—No airplane shall be operated through or over the top of solid fog or clouds except when directional radio is in operation over the route to be flown, and the weather conditions are equal to or better than outlined in one of the following cases: (The provisions of these regulations neither contemplate nor authorize intentional instrument flying for any protracted periods with passengers. They provide only for such flying when it is incident to and made temporarily necessary in carrying out the special flight operations outlined in this section.)

1. When equipped with directional radio and weather broadcast receivers, airplanes are permitted to proceed

per cent reserve, there is an airport or intermediate field where weather conditions are favorable, to which the pilot may be directed further pro-

(c) Specific permission of the operations manager or his properly designated representative is obtained prior to starting through or over the top. Records of such authority in the form of logs of the radio conversation or signed clearance sheets shall be kept in all cases, and further provided that—

believes the flight can be accomplished with safety.

Insert in section 4–A, after paragraph entitled "Over fog and cloud flying" a paragraph entitled "Exceptions to prescribed altitudes of flight":

*Exceptions to prescribed altitudes of flight.*—An exception to the 500-foot minimum altitude requirement of the air traffic rules is granted to airlines

Copy of Air Commerce Bulletin No. 22 with the paragraph marked to which Mr. Purcell refers. This is to be incorporated in a new copy of the regulations about to be issued. According to the above regulations, a pilot in a storm must radio back for instructions, provided that—"The pilot in his own judgment believes the flight can be accomplished with safety."

My dear Mr. "X":

Your letter of June 10th, addressed to POPULAR AVIATION, in which you criticize an article of mine appearing in the July issue, has been forwarded to me for an answer.

It gives me great pleasure indeed to set the XXX Oil Company, on whose stationery you wrote, straight on some of our flying laws as they relate to a pilot. From the fact that you used XXX Oil Company's stationery, I will assume that you are speaking for the oil company itself; in other words, you are speaking for the airlines.*

You start your letter with your transport license number. I am sorry, Mr. "X", that I cannot do the same, but will try to give you a little of my flying experience to prove that my knowledge of the flying game was not taken from Grimm's Fairy Tales, nor from an airline office. You have evidently obtained most of your information from the latter offices.

I started flying in 1915, when you were still taking your meals out of a bottle—several years before the "Jenny" days mentioned in your letter. I would probably stretch your intellect to the breaking point and send you rushing to the nearest library if I mentioned some of the old ships in which I learned to fly, such as Martins with the old Hall-Scott engines, Avros and other ships of the past.

When I first went into the flying game in Uncle Sam's service we were told we had three months to live, and each man's service record had a little notation of where the body was to be sent. I cracked up seven times and two of them were the kind that one does not walk away from. The last one gave me a nice little bed in the hospital for two years.

After leaving the hospital, I barnstormed throughout the country and put in "time" until 1926, when I was automatically washed out of the game by the entry of the Department of Commerce because of my physical condition. This was as it should be, considering the fact that I am carrying total disability from my last crack-up—in other words, living on borrowed time.

However, I have stayed with the game in one way or another. I recently sold a freight and passenger line which was operated off the Berkeley Airport, in which I and several of my friends washed out the bank roll.

I might also state that several of the valued employees of the Department of Commerce were wet-nursed by me when they first came into the flying game.

Giving this synopsis of my past flying experience meets as much with my approval as a dose of castor oil, but I am giving it at the request of the Editor of POPULAR AVIATION, and as a little explanation of why I have no pilot's license.

NOW, FOR your first paragraph. You state that facts have been distorted and that I am leading the reader to believe that airlines are operated in a very inefficient manner. There are no distorted facts in any article that I have ever written, and no mere words of yours to the contrary can change what has been printed. I furthermore *do not* say that the Department has anything to gain by some of its foolish air laws.

A twelve year old child could never find in my article anything, even by the wildest stretching of an ordinary imagination, that would make your statement true. I have said and do say that the airlines are the gainers and not the Department. In my article I do say that the Department is wrong when it places the responsibility of a flight on the shoulders of a pilot without allowing him to use his own judgment in the little matter of flying his ship.

To go a little further in this argument and to prove that the Department does not allow a pilot to fly his own ship, I will refer you to the new bulletin effective January, 1933. This states that a pilot when approaching a storm area, must radio back to his operations manager and ask this bird, sitting in a nice warm office several hundred miles away from the ship, whether he shall go through, over or under the storm.

Maybe you, with your highly trained intelligence, could explain to a poor mere man like me, what this operations manager knows about that storm and how to fly through it? You may say that the operations manager will refer to his weather reports for that district, and on the strength of these and a little guess-work, the Department gives him the right to place the pilot and passengers on the spot.

You mention also "that it is my good fortune as manager of the Aviation Department of the XXX Oil Co. to come in contact very closely with airlines." I note that you closely contact airlines according to your statements, but you make no mention of contacting pilots. Isn't this a rather one-sided affair? You evidently forgot to add that you hope, by writing letters such as this, to get more airline business for your company. In other words, Mr. "X", your interests are with the airlines and the devil take the pilots themselves.

YOU STATE that pilots do not rush into offices for weather reports—that they are handed to them. Mr. Man, that statement places you in the front ranks of the Dodos. One weather report is handed the pilot—sometimes, that is, if the knights of the office chairs can remember this important lit-

* Mr. "X" in a second letter states he is speaking as an individual and not for the company he represents.—Ed.

tle piece of paper. You seem to know nothing of this ritual, so I will explain further for your benefit.

If this weather report happens to be slightly aged, the pilot asks for another report of the district over which he is to fly and this causes a great deal of "rushing." Very often you can find your airline pilot getting his own report from the weather man.

You make another broad statement when you say that an airline does not knowingly overload its ships. You evidently take in all airlines for fear one might feel insulted and thereby lose the sale of some gasoline or oil. For your benefit, Mr. "X", I would state that a lot of our airlines think the Department is cutting down the payload of ships to the point where they cease to make thousands of dollars per hop.

The reason for that is this: An airline, operating mail ships, is paid according to the payload of the ship and not according to the amount of mail carried on certain runs. Anyone, even you, can understand fully why the airlines would like to have the payload of their ships increased. Pilots on all our licensed airlines have taken off overloaded jobs, especially in the smaller classes of single motored ships, which some of our airlines still fly and in which most of our old time pilots have been washed out.

In regard to your next paragraph: Can you tell me of any pilot who has ever been so foolish as to refuse to take an overloaded ship off the ground? I don't think even you would say that an airline has never put out an overloaded ship. Have you any concrete facts to go on when you make these statements, "that airlines do not knowingly overload their ships"? Anyone of average human intelligence knows that many ships on our big lines have been flown overloaded, but I have yet to hear of a pilot who refused to take one of these off the ground.

In fact, I can find no record of it ever having happened. My contention is that a pilot should not have to bear the brunt of the Department's displeasure when he does fly an overloaded job. The blame should be placed where it belongs and that is on the Company's shoulders. If it is necessary to take the pilot's ticket, then the company operating should be made to pay a heavy fine for its infringement of the rules.

GOING a little further in this phase of the argument, I can find no ruling to back up your statement, "that the airline would also have its certificate of operation cancelled and would have severe penalties inflicted on it as well." The only thing an airline suffers in an overload is the loss of its ship for the length of time it takes a wire to get to Washington. In other words, Mr. "X", your above statement is a lot of boloney. The pilot only is responsible, and again I say, this is all wrong.

(*Continued on page* 195)

## Watertight Feature of New Douglas Amphibians

Front view of the new Douglas amphibian of the recently developed type.

WITH AN absolutely watertight cabin, the second of three new Douglas amphibians contracted for by the Army Air Corps for use in the Hawaiian Department, has just been assembled and tested. The unusual feature guards against forced "landings" on rough water for, should the cabin be entirely submerged, not so much as a drop of water could reach the occupants of the cabin.

The original Douglas plane was the first to make the round-the-world circuit, but the present type represents the results of years of experimentation and development from its globe-girdling ancestor.

Duralumin bulkheads and shatterproof glass are other features of this flying boat. Carrying nine passengers to capacity at a top speed of 146 m.p.h., the twin engines of 300 h.p. are highly economical in fuel consumption. Used as a commercial transport, the plane is capable of carrying ten to twelve passengers in comfort, but the present ships equipped for military use require interior space for radio and other equipment. It is designed for a payload of 1845 pounds and its large fuel capacity gives it a wide cruising range.

## Robot Pilots Used on British Bombers

AN entire squadron of big multi-engined bombing planes in the Royal Air Force employs the "robot" pilot, an uncanny mechanism which steers an aircraft with superhuman accuracy on a set course.

"George" or "Iron Mike," to quote two of the nicknames bestowed by the airmen on their metal ally, is also included in the crew of the Fairey long range monoplane which recently flew non-stop from England to Egypt and is expected some time in the autumn to attempt a flight without intermediate alighting over the 6,000 miles separating Cranwell aerodrome, Lincolnshire, from Cape Town.

Many times "George" has steered large landplanes and flying boats unerringly over distances up to 400 miles. He detects deviations from the set course so slight that no human pilot would notice them, and corrects them instantly. Some idea of his method of reasoning and working is given in structural details now revealed for the first time by his suppliers, the famous firm of Smith's Aircraft Instruments.

"George" applies just the degree of movement of rudder and elevator needed to return an airplane to its correct attitude after a deviation; his human colleagues must perforce proceed more gradually by a less efficient process.

For example, the human pilot cannot exactly estimate the precise movement required to correct a deviation. He will undershoot or overshoot. Further manual corrections must be applied to correct the new deviations thus arising, and the result is that the course of the aircraft for an appreciable period of time is along a zig-zag line.

And in misty weather, when no visible horizon is there to guide the human pilot, "George" scores still more heavily than in fair weather flying. His brain needs no visual assistance; the spinning gyroscope records more exactly than the eye any change of attitude and is independent of climatic conditions.

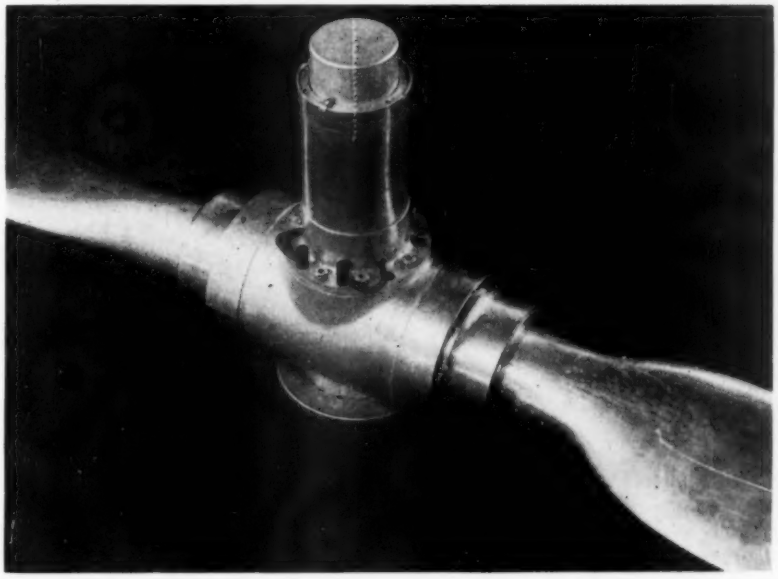
He brings other benefits. Precision of flying increases the range of an airplane and augments fuel economy. The human crew, having no piloting to bother for long periods, may devote calmer minds to problems of navigation or observation. The human pilot may leave his seat and attend to such duties as require his attention; the pilots of the long range monoplane shaved and washed during their flight to Egypt while "George" took complete charge.

Robot pilots have been employed to some extent on American passenger carrying transport planes, as an assistant to the pilot, and within bounds have proved successful.

# A Variable Pitch Propeller Aids Flying

*by* WILLIAM Z. LIDICKER

Details of an advanced variable pitch propeller that has motor adjusted blades and which greatly improves the overall efficiency of propulsion when applied to the airplane. By means of heliocentric gears, with a high reduction ratio, the blade angle can be easily controlled by the pilot.



The completely assembled propeller and hub ready for mounting on the engine shaft. The blades are turned in any desired direction by the housed motor and gears.

BY THE ingenious manner in which a new and unique speed reducer is being adapted to the exacting demands of the aviation industry, we may expect radical changes in present aviation practice with respect to this phase.

This is an adaptation of a 27,000 to 1 ratio heliocentric speed reducer to the mechanism used for changing the pitch of propeller blades while in flight.

The operation of varying the pitch of propeller blades, by means of a motor driven mechanism arranged in the hub of a propeller, is not a new one. But the practical difficulties of obtaining a motor driven speed reducer small enough and light enough to be useful and yet strong enough to provide the necessary blade adjusting torque has so far been a serious obstacle to overcome.

The heliocentric speed reducer combines the elements of compactness, strength and an extremely high reduction ratio on a co-linear axis and because of these advantages, may well be the means of surmounting the handicap of awkwardness and weight common to other reducers of equal reduction ratio.

While only recently introduced into the United States, this speed reducer is not new in Europe, for it was invented in England and was in use there for over eight years.

Entirely different in principle, the heliocentric reducer consists of eccentrics forged to the high speed shaft. As they revolve inside a ring, they force in and out a set of radial plungers which slowly move around in the teeth of a circular rack which is fastened inside the case of the reducer. The plungers are in turn secured to the slow speed shaft.

If there are forty teeth in the rack, then for forty revolutions of the high speed shaft, the set of plungers make one complete turn and a reduction of 40 to 1 is thereby obtained. For higher reductions, several sets of racks are connected in tandem. The input and output shafts are arranged along the same line giving direct axial reduction.

The development and eventual perfection of this device for adjusting the pitch of propeller blades while in flight is another step in the direction of greater safety, higher efficiency and better performance.

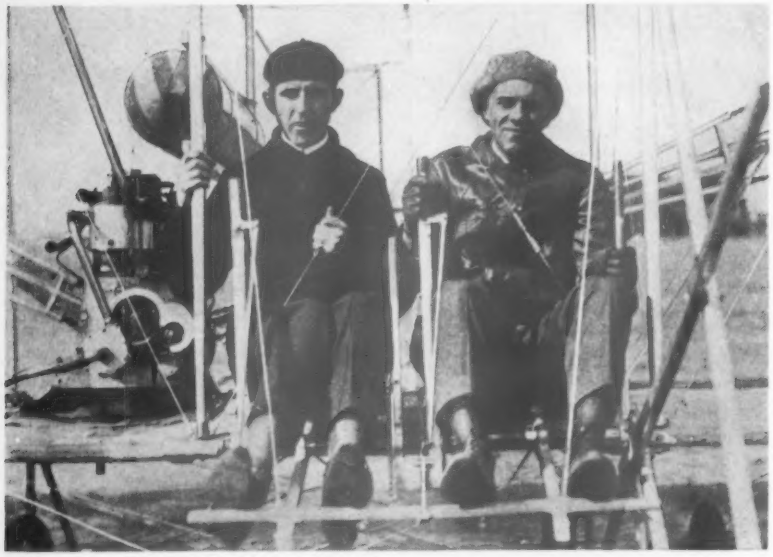
All pilots realize the danger inherent in throttling down the motor at low altitudes. The motor will begin to miss, sputter and may even die entirely with a resulting fatal crash. And yet there is no other way to reduce speed with a constant pitch propeller.

With a variable pitch propeller, however, the pilot has within reach on the instrument board of the plane, a switch controlling the small electric motor encased in the hub of the propeller. A throw of the switch sets in motion the mechanism which slowly turns the blades to a flatter pitch. Less air is moved and though the revolutions per minute of the motor remain the same, the flying speed of the plane is reduced.

Likewise for greater lifting capacity and higher altitudes the pilot can adjust the pitch while in flight.

All of the parts used in the assembly of the variable pitch propeller, the gears, blades, bearings, housings, etc.

## How the Old "Model B" Wright was Flown



Here they are. Turpin at the right and his student all ready for the take-off on the old Model "B".

NOW, no matter what they may tell you, the first commercially practical airplane was a dual controlled ship intended for flight instruction.

This was the old Model "B" Wright ship which had the rudder, stabilizer and elevators all at the rear of the wings. It was the immediate successor of the Model "A" which was distinguished by its forward biplane elevators.

In the accompanying photograph we have the controls where they are easily visible, with the pilot-instructor seated at the right and the student at the left. The pilot shown is Turpin who distinguished himself in the years 1909-1914.

You will note that there are three control "Sticks" in view—one and one-half sticks per person so to speak. And there is absolutely no work for the feet to perform—they just rest idle on the cross-bar foot-rest.

Now, children, concentrate. The middle stick, accessible to both pilot and student, performs two purposes and is divided into two sections. By pulling the center stick back and forth, we have the equivalent of aileron control for lateral balance. In the Wright ship, the wing tips were flexed up or down instead of using ailerons. (Wing warp).

At the top of the center stick is a small pivoted handle which controls the rudder by a twist of the wrist. Thus, when the wings were "warped" by pulling on the stick, compensation was made by moving the handle so as to correct the unequal drag created by the warp. This was exactly the same thing as the present day "Right stick—right rudder".

Both of the outer "sticks" control the flexible elevator surfaces for ascent or descent.

## Aerial Fireworks Display

Writing in fire instead of smoke.

LIEUT. JAMES PARKER, U. S. Army Air Corps., thrilled his Chicago audience nightly with his beautiful evening display during the Military Tournament.

Special pyrotechnic "fountains" attached to his plane left a brilliant stream of fire several hundred feet long behind his plane as he looped, zoomed and rolled, he literally traced his path in a stream of fire, sometimes dazzling white and then subdued to a deep red.

Art Smith performed somewhat the same feat many years ago, but was handicapped by the lack of proper flares. He used standard railroad flares which did not extend more than a few feet to the rear of his old Curtiss pusher plane. But even this modest display was the talk of the times.

## "Blinker" System Marks Army Field

A UNIQUE method of boundary lighting, of great potential value to night flyers, was recently instituted at Bolling Field, D. C.—the Army's air gateway to the capital city. Instead of offering steady illumination, a flicker mechanism permits the intensity of the lights to vary, thus instantly attracting the eye of a pilot who may be bewildered by the bright lights of the nearby city.

The flasher mechanism consists of a crank operated through a 30-1 speed reducing unit by an A.C. motor. Rotated at 38 r.p.m., the crank is connected by a sash cord over a pulley, to a cam and roller arrangement which actuates a moving coil. The movement is such that the lights are at their fullest intensity approximately twice as long as at the lowest.

Formerly, the intensity was evenly divided between bright and dim, but the above change was made in answer to complaints concerning the difficulty of bad-weather landings. The system has been in use at the field for a period of six months, and although not as satisfactory as preliminary tests had indicated it would be, improvements are being constantly suggested and tested.

## A German Sand Scooter

HERE we have the sailing sand-scooter built by Wolgang von Bolton, a German engineer.

It consists of a light frame carrying four wheels, with a mast mounted near the front axle. This greatly resembles the sail-cart built by Louis Bleriot, France, before the war and which was growing popular at the French seaside resorts when such activities were cut short by the war.

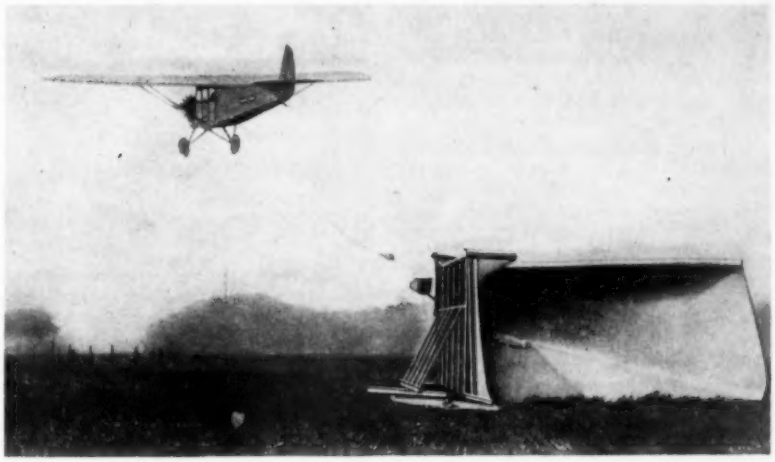
This is a suggestion for our mechanically inclined readers.

We wonder where he puts his head when tacking?

# Mailplane Gathers Cargo Without Stopping

*by* SCHUYLER NORRIS

**Out of the many discouraging experiments with mail pick-ups, comes this simple yet effective device recently placed in regular service. Used either on land or shipboard, its action is positive and its cannot injure either the mail or the plane.**



**Airplane in the act of picking up a mail-bag from the leader trough in the foreground. The bag and ball are just issuing at the left of the trough.**

NOT so many years ago, railroad executives knit their brows over the subject of mail pickup. It had been the practice to stop the train, load the mail and then get under steam once more; a costly operation and a needless one. As time went on, automatic pick-up devices were invented and, at present, the Limited belches smoke as it roars over the countryside picking up and delivering mail without a pause.

Similarly, this will be the history of the airlines. The smaller towns will demand and can use fast air-express and mail service to good advantage. There is no reason why a great deal of time should be wasted in routing airmail over train routes, especially when the possibilities for shuttle routes and airmail pick-up service is just around the corner. Most important of all, however, this new operation will give jobs to hundreds of pilots who will fly these connecting links from the established transcontinental routes to the mail's destination.

It has been demonstrated that the airplane cannot function with maximum efficiency so long as it must be landed in order to take on or discharge short-haul loads. Capacity loads at point of departure have been essential to the financial success of airplane carriers. Time could not be wasted through intermediate landings between point of take-off and ultimate destination. As a consequence and, as mentioned above, only a very small percentage of the nation's population has benefited through air service.

Dr. Lytle S. Adams, a well known dental surgeon in Oregon, went to work on a mail pick-up device about five years ago. This device, which you might have read about before, has now been perfected and officially tested before government officials at Washington. It came through the rigors of this test successfully and was later installed on the after-deck of the steamship "Leviathan", where it is now receiving and delivering mail while the ocean liner plods its way through the seas.

The equipment consists of the pick-up and delivery device—which is a part of the operating plane—and the ground apparatus designed to receive incoming packages and deliver outgoing bags of mail or merchandise to the plane. With the system it is possible to deliver and make a pick-up at the same time.

The equipment on the airplane includes a long, slender cable, wound on a specially designed drum and provided at the free end with a ball of special construction. The shock absorber system is built into the plane to relieve any danger due to strain or shock when picking up a load. It is of spring and rubber construction, operated by compressed air, and acting in exactly the same manner as a wheel shock absorber.

ON THE ground, a steel structure known as the "trap" has sides that converge towards the center. At this point there is a long slot, slightly wider than the diameter of the suspended cable. The pilot, if we follow the mechanical operations of the Adams device, has approximately 90 feet of wire reeled out.

He circles over the trap and maneuvers his ship so that the cable will fall inside the trap and find its way to the slot. The ball at the end of this cable is attached to the mail bag thimble by means of a stud which has been made to fit into slots in both the ball and thimble.

The cable then falls into the trap and follows the slot. It runs along the opening until it reaches the extreme end. Here the ball must run through a small interior opening in order to reach the outside of the trap. While the ball is able to get through this opening, the mail bag thimble is too large. Here the work of the stud enters into the operation, and it serves its purpose by breaking because of the strain placed upon it in trying to pull the thimble through the small opening.

As it breaks, the mail bag falls down on the base of the trap, the ball runs through to slide into the thimble attached to the outgoing mail bag, and both delivery and pick-up operations have been completed.

Another improvement to the Adams device should also be mentioned here. As the ball enters the thimble and begins to pull the bag from its container, it pushes a small trigger immediately in front of the thimble. The trigger is connected to the large springs and, as it is sprung, it releases the springs which act as a catapault with a speed of 65 miles per hour.

ALL sudden strain is taken from the pick-up in this manner. The telescopic shock absorber, operated by compressed air, prevents any possibility of the swinging ball being catapaulted over the plane's wings or into the fuselage, should failure to contact the pick-up baggage result.

To explain this latter, we can only refer to a well-founded principle that it is not possible to swing (in a circular fashion) a constantly changing length of cable. In case a slip occurs in pick-up, the shock absorber will immediately begin to equalize the effects by its action upon the length of the cable, preventing it from making a wide swing into the ship.

The ground apparatus of the Adams device is mounted on a removable, revolving base so that it may be turned at will. This enables the ground operator to manipulate the trap in order that the pilot may take full advantage of wind direction in handling his plane.

Precautions have also been taken to prevent accidents. For instance, a friction clutch on the drum of the plane's pick-up device allows slippage in case of slight entanglements. The cable is also so constructed that it will snap

(*Continued on page* 195)

# How to Design Floats for

*by*

HARRY S. MAGILL

*Aeronautical Engineer and Designer, specializing in Seaplanes and all-metal construction.*

FLOAT DESIGN is a subject which has received surprisingly little attention from aeronautical writers. What information the builder does find available is often so filled with complicated and lengthy calculations that it is very confusing.

In the preliminary design, the designer assumes approximate dimensions for the float or floats. This can be done with reasonable accuracy by comparing the design in question with several similar successful designs. Upon this assumption, the weight estimate of the seaplane is compiled which gives the gross weight as well as the allowable design weight of the float or floats.

In ordinary practice, the displacement of the float landing gear in pounds is generally about one hundred ninety percent of the gross weight of the ship.

In the case of wing-tip or outboard floats, the displacement is governed by the distance they are placed from the center-line of the main hull and the righting effort that is necessary. The righting effort required by the Department of Commerce, according to Aeronautics Bulletin 7-A, is one and one-half times the overturning moment or the tendency toward overturning the craft.

A preliminary sheer and body plan layout of the float is then made. This can be one-eighth size (1½ inch = 1 foot) for convenience. The sections shown in the body plan should be an odd number and should also be equally spaced along the base line. This is done so as to facilitate the use of "Simpson's First Rule" for the calculation of displacement.

Figure 1 shows a preliminary layout of this sort for an outboard float of the type used by the U. S. Navy on monoplane patrol boats. The displacement of the preliminary design can now be easily determined by the process shown in Table I. The values shown in the table are taken from the layout in Figure 1. In the first column, the stations are listed from the "F.P." (forward perpendicular) to the "A.P." (aft perpendicular).

In the second column, the area of each section is listed. These areas are measured from the sections shown on the body plan by means of a planimeter or by some similar means. In the third column we put the respective "Simpson's Multipliers", derived from Simpson's First Rule. In the fourth column we list the functions of areas obtained by multiplying the values in column (2) by those in column (3).

These "functions" or numbers are then added together and the sum is then divided by one-third of the common spacing between the stations. The result will be the *displacement* of the float in cubic feet. To convert this displacement in pounds, multiply the cubic feet by the weight of one cubic foot of water which is sixty-four pounds for sea water or sixty-two and four tenths for fresh water.

When the displacement in pounds is arrived at—if the value is not approximately the displacement desired—some of the major dimensions of the float must be either increased or decreased until the error is less than fifty pounds either way. During the alteration of the displacement, the designer must keep in mind the fact that the lines must be fair in the final design. After every change in the lines the displacement calculations must be gone through, using the new sectional areas.

In order to avoid any confusion over the use of Simpson's Rule, we will go over the theory of its application to the present case. We shall assume a base line (AB) as in Fig. 2, and divide it into an equal number of spaces. We then erect perpendiculars corresponding to the stations on the float sheer layout.

The values of the station areas are then plotted on their corresponding perpendiculars measuring from the base line, using a convenient scale—say one inch equals one square foot. A smooth curve is then drawn connecting all of the points. By the calculation of the areas under the curve, we obtain the displacement of the float. This calculation, or "integration", is performed by the use of Simpson's First Rule which is quoted as follows:

*"Divide the base line into a convenient even number of equal parts and erect ordinates meeting the curve. Then, to the sum of the end ordinates add four times the even ordinates and twice the odd ordinates.*

*"The sum, thus obtained, multiplied by one-third of the common spacing of the ordinates, will give the area under the curve."* This rule applies to parabolas of the second order. It is used in displacement calculations in all forms of naval architecture. For parabolas of the third order Simpson's Second Rule is used.

When the general lines and the displacement of the float have been decided upon, we must next determine the location of the "C.B." or "center of buoyancy". Again referring to Table I, we find in column No. 5 the distances of the various stations from the F.P.

In the last column the moments of areas are listed. These are obtained by multiplying the sectional areas by their respective lever arms. The longitudinal position of the C.B. is then determined by dividing the sum of the moment of areas by the sum of the sectional areas.

TABLE I

| Station | Area | Simpson's Multiplier | Function | Lever Arm | Moment of Area |
|---|---|---|---|---|---|
| F.P. | 0 | 1 | 0 | 0 | 0 |
| 1 | 2.083 | 4 | 8.332 | 16 | 33.328 |
| 2 | 3.438 | 2 | 6.876 | 32 | 110.016 |
| 3 | 4.201 | 4 | 16.804 | 48 | 201.648 |
| 4 | 4.563 | 2 | 9.126 | 64 | 292.032 |
| 5 | 4.715 | 4 | 18.460 | 80 | 377.200 |
| 6 | 4.813 | 2 | 9.626 | 96 | 462.048 |
| 7 | 4.826 | 4 | 19.304 | 112 | 540.512 |
| 8 | 4.736 | 2 | 9.472 | 128 | 606.208 |
| 9 | 4.438 | 4 | 17.752 | 144 | 639.072 |
| 10 | 3.542 | 2 | 7.084 | 160 | 566.720 |
| 11 | 2.063 | 4 | 8.252 | 176 | 363.088 |
| A.P. | 0 | 1 | 0 | 192 | 0 |
| Totals | 43.418 | ..... | 131.088 | ..... | 4191.872 |

$$\text{Displacement} = \frac{\text{Sta. Spacing (feet)}}{3} \times \text{Sum of Functions}$$

$$= \frac{1.333}{3} \times 131.088$$

$$= 58.118 \text{ Cubic Feet}$$

$$= 58.118 \times 64 = 3719.552 \text{ Pounds (sea water)}$$

$$\text{C.B.} = \frac{4191.872}{43.418} = 96.546 \text{ Inches Aft of F. P.}$$

# Small Hydro-Aircraft

*COMPLETE rules in simplified form, are given for designing floats or pontoons for small seaplanes and other hydro-aircraft. By these rules it is easy to design and build the floats for that lightplane of yours. This article has been requested by many of our lightplane builders — so here it is.*

In order to determine the distance of the C.B. below the load waterline (L.W.L.), the use of Normand's Approximate Formula is sufficiently accurate for use on aircraft floats and hulls. This rule is based on the assumption that the area of the displacement curve, divided by the load displacement gives the distance of the C.B. below the L.W.L. The proof of this formula may be found in most textbooks on naval architecture. The formula is as follows:

$$\text{C.B. (below L.W.L.)} = \tfrac{1}{3}\left(\frac{d}{2} + \frac{V}{A}\right)$$

Where V = Volume of displacement up to L.W.L. A = Area of Load Water Plane in square feet. d = Mean draft in feet.

The curve of displacement referred to here is a graph showing the increase in displacement when the float is loaded to different depths. To find the volume of displacement up to the L.W.L., we use the same process that we used to find the submerged displacement, the only difference being that the sectional areas used are the areas of the sections below the "Load Water Plane".

The area of the Load Water Plane can be gotten by laying it out on the sheer layout and calculating the area. The "mean draft" is the average of the distances from the L.W.L. to the keel.

A more accurate method of finding the vertical position of the C.B. is to pass a series of water planes through the float in the same way that we located the stations in the displacement and longitudinal C.B. calculations. They should be parallel to the base line.

We then find the areas of the sections cut by the water planes, multiply them by their respective distances from the base line and divide the sum of these products by the sum of the areas. The result will be the distance from the base line to the C.B.

From this point on, in the case of the single or twin float type of seaplane, the designer must locate the float so that the C.G. of the plane is in a perpendicular line with the C.B. of the float or floats when looking at the side view of the ship in flying position.

In the case of the flying boat, where the designer is concerned with the outboard or wing-tip floats, the position of the C.B. of the floats with respect to the C.G. of the ship is not so important, as the floats are entirely out of the water when the hull is planing on the step. However, it is desirable to keep the centers of buoyancy of the floats and the hull as near on a line as possible for other reasons.

Before the final table of offsets is

(*Continued on page* 201)

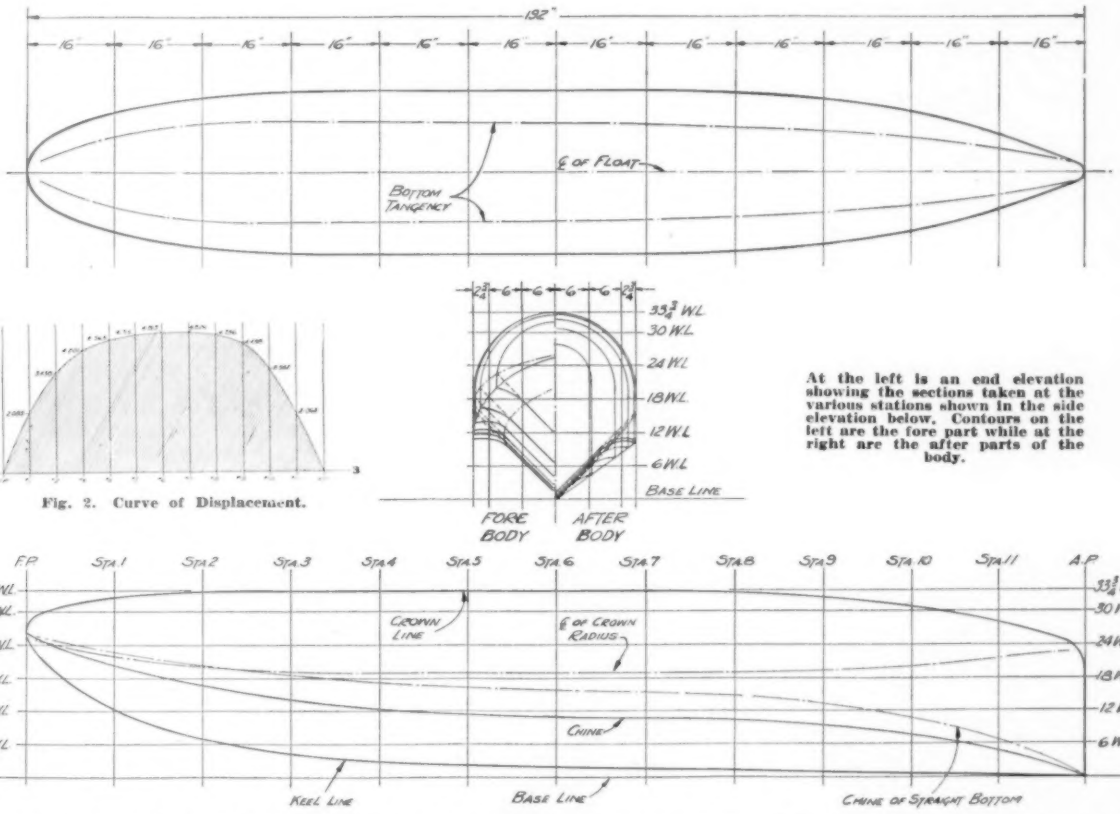



Fig. 2. Curve of Displacement.

At the left is an end elevation showing the sections taken at the various stations shown in the side elevation below. Contours on the left are the fore part while at the right are the after parts of the body.




Figs. 1-2. Complete layout of the floats described in this article, which are drawn to scale in the manner shown by the designer. The dimensions shown on the drawing appear in Table 1, shown on the opposite page.

## The Gull Winged Monoplane Is Novel

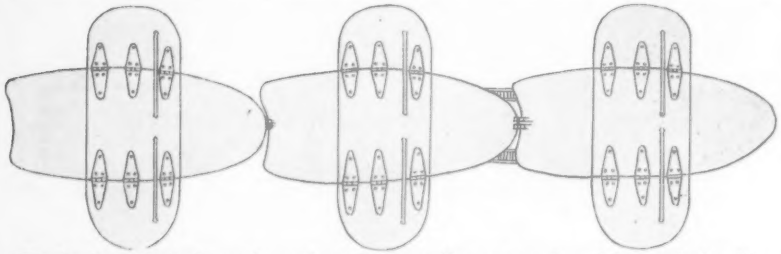
Frone view of the Gull-Winged monoplane. Note the elliptical wings and their attachment at the body.

CAPT. VINCENT MALLOY of the U. S. Militia, War Department, is making a tour of all the National Guard units in the new type Gull Winged monoplane shown by the accompanying photograph.

The wings are of a type proposed by many authorities as being the ideal type of lifting surface—semi-elliptical and tapering both at the outer tips and at the body.

Unfortunately, this type of construction does not lend itself very readily to the self-supporting cantilever type of wing structure owing to the narrow inner ends, hence external bracing of the cabane type was necessary as will be seen in the photograph.

## Proposed Aircraft Transport Trains



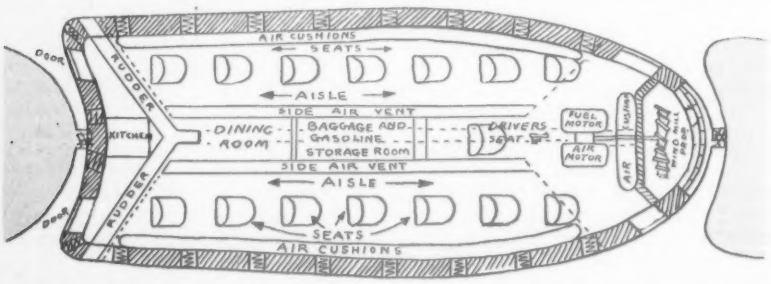
Showing how the train can be made up by connecting any number of independent units.

VISUALIZING vast air transport systems of the future, Harry Castady, Chicago, has designed and taken out patents on a novel aerial transportation system shown by the accompanying drawings.

To accomplish his purpose, Mr. Castady has adopted a unit system of airships of the ornithopter or flapping wing type. These units can be operated independently or connected up in trains of as many units as may be desired. Three units are shown connected up in one of the illustrations.

As will be noted, the hulls of the units are convex at the nose end and concave at the rear, so that when they are connected up, we have in effect, a ball and socket joint that permits free motion between the units in making a turn or when operating in rough air.

The units are driven by blowers on the reaction principle, and support is assisted by helium gas chambers in the upper portion of the hull. Shock absorbers are imbedded with the wall.




Sectional view of one of the proposed units, each one containing its individual power-plant as in the case of a multiple unit train.

## Rubber Covered Fuel Tubing

FOR several years, the Army Air Corps has been experimenting on metals and material for fuel lines, other than copper tubing. Day after day, the vibrating machine has been running continuously in an effort to obtain a tubing which would offer greater resistance to the deadly power of vibration, but which would at the same time decrease rather than increase, the weight of the plane. Alloys of aluminum have been used, giving approximately the same results as did copper, but with the added benefit of lightness.

Recently, experiments in which tubing of aluminum alloy has been covered with rubber, have been made, resulting in the promise of a more efficient durable satisfactory type of fuel line than any that has ever before been developed.

Several preliminary defects were avoided when it was decided to indirectly vulcanize the rubber to the outside of the tubing. In the fittings, the tube was flared at the end, and the rubber layer turned over inwardly, so that the sealing and shock absorbing qualities of the rubber were utilized at joints, also allowing flexibility there.

Designed in this manner, the tube may be cut to any desired length, without losing any of the advantages of the type. This aluminum flared construction of the fuel line has stood two hundred and fifty hours of testing in the vibrating machine, as against an average of but twenty-five hours for the standard copper tubing, or unprotected nickel or aluminum line.

Not only does this development combat damage from vibration, but *should* the fuel line break, the rubberized outside will prevent leakage of fuel, eliminating, of course, much of the fire hazard present when a gas line breaks.

The Air Corps is installing the covered aluminum tubing on many planes for extended, active service tests.

## A Weather Forecaster

A PIECE of blotting paper, saturated in a suitable solution, makes a fairly reliable weather forecaster.

Cut the blotting paper to a convenient size and saturate in the following solution:

| | |
|---|---|
| ½ oz. | sodium chloride |
| 1 oz. | cobalt chloride |
| 75 gr. | calcium chloride |
| ¼ oz. | gum Arabic |
| 4 oz. | water |

Keep the blotting paper in the solution for at least an hour. Dry thoroughly and mount on a well-varnished board.

Hang the board out-of-doors, but in a sheltered place. Rain and snow, striking the paper, will soon destroy its usefulness.

The weather is foretold by the color of the paper. Blue indicates dry and fair weather, lilac shows slight rainfall (showers), soon, and red indicates rain and storms.

# Simple Lessons in Meteorology

*by* JAMES A. SIMPSON

PART I

*Jim, who isn't getting on with his weather studies at school, is coached by his old friend, Charley, who is instructor at a flying school. This letter is the first of a series that gives valuable instruction in the science of meteorology. There is both humor and information in these letters.*

**Fleecy Cumulus clouds are a feature of the June landscape, entensely white against a deep blue background of sky. Thes clouds preceeded a thunderstorm by two hours.**

Dear Jim:

Your letter blew in at a time when I was feeling mighty low and plumb disgusted with my fellow men after a two-hour blackboard battle with a bunch of dumb bunnies who think they want to become aviators, and Boy, you have no idea how that familiar handwriting of yours did cheer me up!

You big long-legged, banjo-eyed palooka, why the heck haven't you kept me posted on where you were and what you were up to? The latest word I've had from you, until your letter came in today, was last winter when you wrote me that selling cars was pretty flat and you were figuring on going over to Shanghai as a buck private to see if you could get into some kind of a first class fight over there.

Apparently you changed your mind. Or may be you *did* go after all, and have come back looking for more trouble by going in for aviation, as you say, "in a big way."

Boy, you'll find plenty trouble on your hands if you ever let some of your instructors out at Air City know what you really think of them, as indicated in your letter to me!

If you want my frank opinion, Jim, your trouble seems to be due pretty much to your thinking you know more than your instructors. Mebbe so, Jim, when it comes to selling 4-cylinder automobiles. But what you don't know about this flying racket would fill a book — in fact, two books — about the size of the New York City directory.

You come to me with your problem because you are willing to admit to yourself that my "twenty years in aviation convinces me you really know your stuff." This would be funny as a crutch coming from any one but you. Of course, Jim, I'm flattered to know you wish I were out there as one of your ground school instructors.

I've read your letter through several times, Jim, and from what I know of "green timber" such as you are, I think you are doing all right. Most young squirts like you feel as you do about the ground school end of it, Jim. I've taught hundreds of 'em in the last few years, and they're all alike.

HOWEVER, from what you tell me about the meteorology wizard on the Air City staff, he either does not know his stuff or doesn't know how to get it across. My guess is that he lacks the ability to make a dry subject interesting. That's pretty near fatal to success in teaching.

You say in your letter: "What's this meteorology stuff all about? I can't make head or tail out of it, or why we even have to study it.

"I know enough to come in out of the rain and I sure wouldn't take my ship up in a thunderstorm or a tornado, or try to ram a waterspout.

"Even when old Binks is talking about rainfall charts it's dry as dust. All the other fellows feel as I do about it. Now, Charley, you are a pretty wise old bird. I'll listen to your advice, and heed it, and if you'll take the time to make me 'weather-wise' by good old U. S. mail, I'll surely appreciate it. I know it's asking a lot, but I'm a flop on this meteorology stuff, and I'm honest enough to admit it."

That sounds so much like you in the old college days, Jim, that it's funny. However, I'm too good a friend to let you down, so I have just about decided to give you the works and *make you like it.* I mean, Jim, make you realize the importance of meteorology to aviation and see that you get at least a blankety-blank good grasp of the fundamentals. So here goes.

THE first idea I want to register in that thick skull of yours is that "weather" is an all-fired important thing for you to know as much about as you can. The trouble with most human beings is that they take the weather for granted.

You know what Mark Twain said about it: "People are always kicking about the weather, but nobody ever seems to do anything about it." Well, Jim, in aviation you just have to do something about it.

The mark of a good pilot is to play safe. Safety of passengers, safety of ship, mail or the pilot's own personal safety, are primary considerations and all of these are at the mercy of meteorological conditions.

After you have had the jitters a few times trying to figure which course to take in flying around a storm center, or in knowing whether to buck a line-squall or turn and run for the nearest landing field, you'll know what I mean.

Fogs, hail, snow, rain, wind, sleet—are a few of the conditions you are going to meet up with many times in your young life, and you've got to know when to expect them and what to do when you meet 'em.

As you probably know, our benevolent government maintains a weather observation and forecast service that is probably the best in the world. The Department of Agriculture, through the Weather Bureau, co-operates with the Department of Commerce in getting the weather dope to all and sundry, including the aviator.

And if it is important for the farmer to know what the weather is going to be like, for the fresh or salt water sailor, or for the big shippers of perishable merchandise, you need only one guess as to how important it is for the aviator. Boy, howdy, it is all-important. So Uncle Sam makes observations of weather facts at some 250 widely scattered points twice a day, and these observations are collected at strategic points for transmission to the whole cock-eyed world, if necessary.

Control centers and airports now get fast service from the various observation points. Along airways with dense traffic the Weather Bureau network reports flying conditions every three

hours to suitable control centers. In addition, intermediate landing fields report conditions every hour and terminal fields every half hour.

SO YOU see, Jim, this meteorology stuff is mighty important. When you get real familiar with it, you'll have a lot of respect for it. The reports you get will tell you whether to stay aloft or ground your ship; whether to go around a disturbance or under or over it; whether to take off on schedule or lie doggo until it's safe to make your getaway.

Now, Jim, I'm going to get down to some of the hard-pan on this meteorology stuff. In the first place, what *is* "meteorology," or "aerology"? Well, Old Timer, the dictionary I have here (if you own one you had better look it up yourself to make sure I am not kidding you) says that meteorology is "physics treating of the atmosphere and its phenomena, especially of its variations of heat and moisture, of its winds, storms, etc."

Now I want you to notice two words in this definition—physics and etc. It may be that you have an idea this means medicine when it says "physics", but you will be way off—except when you bump into some really tough words in meteorology which is plenty bad medicine and you will, when the time comes for you to take your dose of it, prefer the good old-fashioned physic that comes in a bottle. And I don't mean maybe!

NOW Jim, the purpose of this and my subsequent letters in answer to your pathetic plea for light on this meteorology stuff, is to tell you a little about the etc. part of it. A little about the atmosphere itself, about the instruments used in recording meteorological observations, about clouds and what they are good for—if anything, about weather maps, and how to read 'em (and weep), about how wind, water, and all the rest of it, including cyclones, hurricanes and tornadoes, may be bucked, outwitted, laughed off or used to advantage in flying.

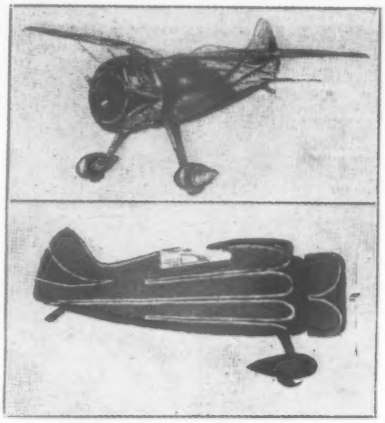
Now right about here is where the heavy shooting begins. I suggest you make some fancy notes of a few facts, if you really think this guy Binks has the Indian sign on you.

In the first place, let's take a look at the fundamental of meteorology—atmosphere. The envelope of atmosphere around this depression and politics-infested world of ours is a good many miles thick. We know, that up to about seven miles, the component parts of the atmosphere are about the same—78 per cent nitrogen, 21 per cent oxygen and the other one per cent made up chiefly of argon, with a little carbon dioxide, hydrogen, neon and helium thrown in for good measure. In addition there is a small amount of water vapor.

I imagine you never have thought of just plain, ordinary air as being so blamed complex. Take it from me, how-

(*Continued on page* 200)

## Russell Thaw's New Thompson Trophy Racer



Two Views of the Thaw entry.

WITH the greater part of its metal work already completed and work progressing rapidly on the wings, the Thompson Trophy racer, being built at Springfield, Mass., for Russell Thaw, New York sportsman-flier, is nearing completion at Springfield Aircraft Company, Inc. The ship will be test hopped in time for its designer, Robert L. Hall, to work out of it any "kinks" that arise during its infancy.

Hall, co-designer with Z. D. Granville of the 1931 Thompson Trophy winner, "City of Springfield," worked for more than six months on the plans for the Thaw ship, intending to fly it himself in the hope of once again bringing victory to Massachusetts. He aided in designing the "City of Springfield" while with Granville Bros. Aircraft, Inc., in 1931. This firm is planning to enter two ships in the National Air Races, one to be flown by Russell N. Boardman, Transatlantic flier.

In the Thaw ship, Hall has attempted to get away from the conservative decorative scheme now employed by most manufacturers of aircraft. The Thaw ship will be scarlet with black areas on its wings, a black blotch on its nose and black stripes lengthwise on its fuselage. The ship has an enclosed cockpit and a new type of landing gear developed by Hall. Streamlined in its every part, the ship has this feature even extending to the heads of bolts and other exposed parts. Hall expects to reach a speed greater than 300 miles an hour in his ship and will test hop it himself before turning it over to Thaw. Thaw, 21 years old, will be one of the youngest pilots in the great American air classic when it opens on August 27.

Specifications of the Thaw and 1931 winner follow:

TABLE OF COMPARATIVE DIMENSIONS

| | Thaw Racer | City of Springfield |
|---|---|---|
| Weight Empty | 1750 | 1550 |
| Pilot and chute | 170 | 170 |
| Full load (gross) 3235 | 3235 | 2428 |
| Light load (25 gals. of gas) | 2185 | 1961 |
| Wing loading (full) | 39.6 lbs. sq. foot | 34.7 lbs. sq. foot |
| Wing loading (light) | 26.8 lbs. sq. foot | 28.0 lbs. sq. foot |
| Power loading (full) | 4.3 lbs. sq. foot | 4.52 lbs. sq. foot |
| Power loading (light) | 2.9 lbs. per h.p. | 3.65 lbs. per h. p. |
| Fuel | 206 gallons | 103 gallons |
| Oil | 15 | 12 |
| Power | 750 plus | 535 |
| Wing area | 81.5 | 70 |
| Landing speed (full load) | 98 | 92.5 |
| Landing speed (light) | 81 | 83.5 |
| Top speed | 300 plus | 267 |

## A Special Drill for Dirigible Frames

Drilling holes in dirigible frames.

IN dirigible frames, such as the structure of the "Akron" and the "Macon," the rivet holes are so close together and are so close to other structural parts, that an ordinary drill cannot be used.

Therefore, a special electric drill with a flexible shaft has been devised by an Akron, Ohio, mechanic that will drill close up into the corners without any of the former difficulties being experienced. As a matter of fact, the drill can be approached in a distance of half the chuck diameter, and by slanting the drill, the hole can be made even closer. This is an idea that will also find application in airplane building and other industrial processes of a like nature.

# What Happens in the Cylinders of the Engine

*by* FRANKLIN R. JOHNSON

Just how the pressures vary inside of the aviation engine cylinders during different parts of the cycle, and how they affect the performance of the engine.

AT first glance, there does not seem to be any similarity or connection between the operation of a gasoline aviation engine and a steam engine, and yet they basically belong to the same general type. Both are heat engines that convert the heat energy liberated from a burning fuel into mechanical power for turning the propeller and flying the ship. Both also conform to certain principles of operation.

The steam engine, known as an "external combustion engine" is so called for the reason that the fuel is burned outside of the working cylinder of the engine, as under a boiler or steam generator. In the case of the modern gasoline or Diesel aviation engine, the fuel is burned directly within the working cylinder, thus receiving the name of an "internal combustion engine."

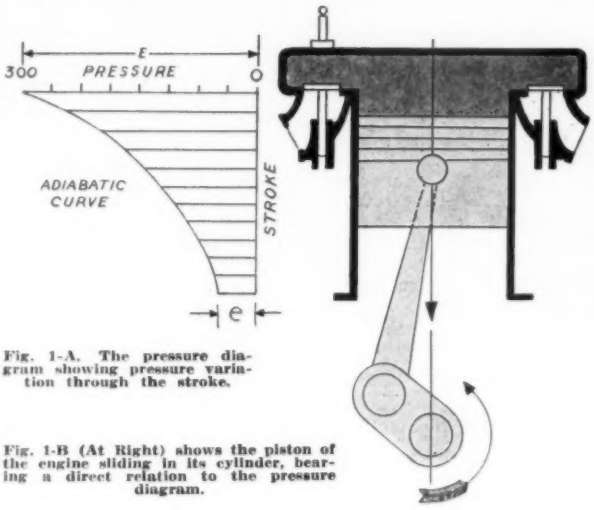



Fig. 1-A. The pressure diagram showing pressure variation through the stroke.

Fig. 1-B (At Right) shows the piston of the engine sliding in its cylinder, bearing a direct relation to the pressure diagram.

Now, let us take the case of the internal combustion engine, most commonly used for propelling airplanes at the present time. Its fuel, as indicated by its name is gasoline, a light volatile petroleum product that vaporizes with comparative ease at ordinary temperatures to form a combustible mixture. After vaporization, the vapor is mixed with a sufficient amount of air to burn it, and the mixture of fuel and air is then drawn into the cylinder by the suction of the piston.

After the cylinder is filled, the next stroke of the piston compresses the charge so that its volume is much reduced with a corresponding increase in the pressure and temperature. An electric spark, occurring near or at the end of the compression stroke, ignites the charge which then burns rapidly and causes a further increase in pressure due to the expansion of the gases by the heat generated by the combustion. This is in no sense an explosion, but simply a very rapid combustion taking place within the cylinder. Heat is produced and the heat produces the pressure necessary for forcing the piston against the load.

It is most important to note that the combustion should theoretically take place before the piston starts to move down on the next stroke, hence for ideal operation, the combustion takes place while the cylinder volume is constant. This gives the carbureting gasoline engine the name of "constant volume engine". In actual practice, however, combustion proceeds to some extent throughout the stroke so that the actual gasoline engine is far from being the ideal type for operation according to theory.

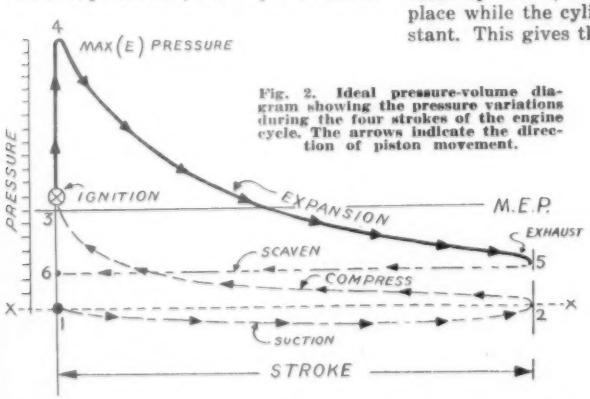



Fig. 2. Ideal pressure-volume diagram showing the pressure variations during the four strokes of the engine cycle. The arrows indicate the direction of piston movement.

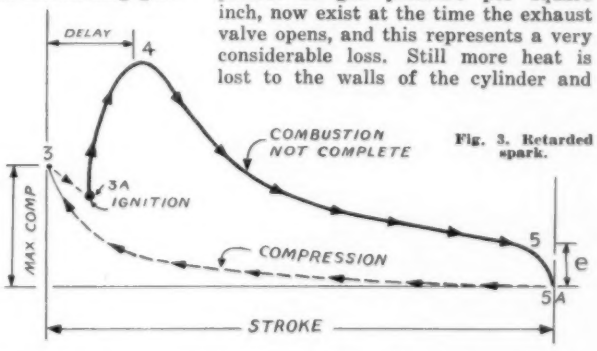



Fig. 3. Retarded spark.

With the pressure of the hot expanded gases acting on the piston, the piston is forced against the load through intermediate members known as the connecting rod, crank and crankshaft. As the volume of the gases continually increases or "expands" during this working stroke, the pressure falls off rapidly, with a fall in temperature until the end of the stroke is reached. Then the exhaust valve opens and allows the burned gases to rush out into the atmosphere through the exhaust ports.

TO obtain the last drop of energy from the combustion of the fuel, the expansion should be so complete that the pressure of the gas would be reduced to atmospheric pressure with the temperature of the gas reduced to atmospheric temperature. In practice, however, it is impossible or rather impracticable to carry the expansion this far, hence there is always a considerable pressure and temperature existing in the cylinder at the end of the working stroke when the exhaust valve opens. That this pressure exists is made evident by the roar of the exhaust gases issuing from the exhaust and the thin flames that lick around the exhaust ports as they emerge.

The exhaust gases carry away a great deal of the heat that might otherwise be utilized for producing power, but unfortunately, this defect in the internal combustion engine has not yet been solved. Anywhere from 10 to 50 pounds of gas pressure per square inch, now exist at the time the exhaust valve opens, and this represents a very considerable loss. Still more heat is lost to the walls of the cylinder and thence to the cooling system, so that the engine seldom converts usefully more than 30 per cent of the energy in the fuel. The remaining 70 per cent of the fuel energy is frittered away in various heat losses and friction.

For practical reasons it is necessary to cool the engine, one reason being that the lubricating oil demands a temperature lower than 500 deg. F. The necessity for oil lubrication, therefore, reduces the efficiency of the engine.

Now, getting back to the beginning of the operation at the point where the

gasoline-air mixture is drawn into the cylinder, we find that the amount of mixture taken into the cylinder is governed by a number of factors, but principally by the degree of vacuum established by the piston. This piston reduces the pressure on the inside of the cylinder while the outside atmospheric pressure actually forces the charge into the cylinder. The rate of mixture flow is therefore proportional to the difference of pressure between the inside and outside of the cylinder.

Since the atmospheric pressure is seldom higher than 15 pounds per square inch, even at sea-level, it will be seen that the force causing a flow of mixture is very slight under the best of conditions, and when at high altitudes where the atmospheric pressure is still lower, that it is only possible to get a part of the charge into the cylinder. This means a reduction in power since the amount of power developed depends largely upon the weight of fuel taken into the cylinders.

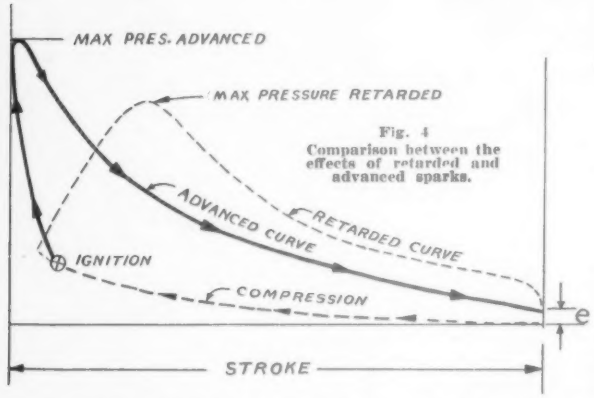



Fig. 4
Comparison between the effects of retarded and advanced sparks.

To improve this condition, it is now common practice at high altitudes to force the mixture into the cylinders by a compressor commonly known as a "supercharger" in aviation vernacular.

And now, we get to the subject of compression which follows the suction stroke. At first glance, it would seem that power would be wasted by compressing the mixture as work is being done upon it, but as a matter of fact the efficiency and output of the engine is very greatly improved by the compression of the mixture. This fact will be attested to by any motorist or aviator who has had an engine lose its compression through any cause.

In the first place, the compression of the mixture raises its temperature, thus completing the vaporization of any liquid gasoline particles that have passed into the cylinder without previous vaporization. Secondly, the volume of the gas is so reduced that there is less heat lost to the cylinder walls for the simple reason that there is less gas in contact with the cylinder walls. The volume and cylinder contact at the end of the compression stroke is only a small fraction of these dimensions at the end of the suction stroke.

Thirdly, the volume of the gas is so reduced that the flame sweeps through the mass much more rapidly after ignition. Fourthly, the rate of flame spread or propagation is assisted further by the more positive action of the spark on the hot mixture. All these factors, taken together, much more than offset the expenditure of power required for compressing the mixture. The engine, with a high compression, consumes less fuel per horsepower-hour and a greater amount of power is obtained from each cubic inch of volume displaced by the piston in its stroke.

THIS cycle of pressures in the cylinders is illustrated by Fig. 1 where a cross-sectional view of the engine is shown at the right and a pressure diagram, corresponding to the piston movement, is placed at the left. On the diagram, the stroke is represented by the vertical line starting at (0), while the corresponding pressures are indicated by the horizontal scale of pressures (0-300). For each position of the piston there is a corresponding pressure, whether the piston be considered on the compression stroke or on the working stroke.

Let us say, for example, that the piston be considered as moving down on the working stroke or power stroke as indicated by the arrows. At the beginning or upper end of the stroke the pressure (E) is 300 pounds per square inch. When the piston descends with increasing volume, the pressure falls off gradually until it is reduced to (e) at the end of the stroke when the exhaust valve opens. This pressure decrease is not a uniform straightline decrease, but is along a curved line indicated as an "adiabatic curve."

Now, if we consider the piston acting in the opposite sense—compressing the mixture on an upward stroke, then the pressure of the mixture will increase from (e) at the beginning to (E) at the upper end of the compression stroke. The pressure increase during compression is more rapid than a straight-line increase for the reason that the temperature also increases in addition to the decrease in volume.

Now, understanding these points, we can lay out a pressure diagram for all four strokes of a four-cycle engine as illustrated in Fig. 2. In this diagram, the piston position is indicated by the horizontal scale marked "stroke", while the pressures are measured off vertically from the line (X-X). The line (X-X) is called the "atmospheric line"

(*Continued on page* 193)

## Loop-the-Loop

A typical old time bicycle loop.

THIS old time circus stunt, is familiar to most of us. Someone whispered the magic word, "centrifugal force" in our ear. That was why the rider did not fall when at the top of the loop.

Many readers write in to our editorial office asking why a pilot does not fall out of his seat when looping-the-loop.

For the benefit of those readers, and any others who are wondering—it is the same force. Simple, isn't it? The pilot cannot leave his seat if he wanted to, safety belt or no safety belt.

As long as the plane is moving in the loop, the pilot sits a little harder in his seat, depending on the tightness of the loop and the speed of the plane. Sometimes the force is so great that one feels as if a heavy weight was holding him down.

## Transparent Steel Coverings

A recent invention is the use of a steel wire mesh reinforcement for a transparent covering. Through this covering all internal controls and stays are visible.

Rudder made of transparent steel.

## Steam-Powered Stratosphere Plane

REPORTS are current in Europe of a new plane power plant, consisting of a flash-generator and a high-speed turbine, with condensation and recirculation. The inventors are reported as experimenting at Cleveland, Ohio.

The proposed plant will be independent of atmospheric density and the ceiling will be limited only by the adaptability of the propeller angle to the needs for upper-air flying.

## Women Are Airminded

WOMEN are becoming more air-minded, statistics compiled by the United Air Lines show. Not long ago many men gave as their excuse for not flying "My wife won't let me." But during 1931 women made up 20 per cent of the 43,000 passengers carried by the United Air Lines, and that the proportion is gaining is shown by records for January and February of 1932 indicating 30 per cent of the passengers carried were women. Mates and stewardesses on the lines say women take their flying in a very matter of fact manner and are more interested in scenery than the men, who often use the airlanes just for speed.

## A Variable Area Arrangement

ON THE airport landing field at Ber-Tempelhof, was demonstrated an airplane with variable area planes, invented and built by Prof. Dr. Schmeidler of the Breslau Technological Institute.

It is the first time that such an airplane has been built in Germany. The experimental machine, built by simple means and having a motor of only 45 h.p., shows a form of construction in which are provided two movable members carried on the body. Each of these mounted on a pivot outside on the sustaining plane may be swung out backwards.

This enlargement of the sustaining plane area by 20 percent, effects a shortening of the take-off run by one-third to one-half. The reduction of a speed acceleration in horizontal flying varies from 69 to 84 m.p.h.

At (G), are the variable wing flaps for varying the effective area of the wing.

## Sandhill Ranchers Find Planes a Necessity

This plane helps make ranching easy. Within a few hours a vast territory can be surveyed.

RANCHERS, who operate large tracts of land in the sparsely settled sandhill region of western Nebraska and southwestern South Dakota, are coming more and more to appreciate the use of the airplane in operating their ranches. Already, various uses ranging from coyote extermination to riding herd on the cattle have been found for ranch-owned planes.

Tom Arnold, who operates the 100,000-acre XU ranch in northwestern Nebraska and southwestern South Dakota, finds his four-place cabin plane indispensable in conducting the business incident to a large-scale ranching, and the plane is one of the busiest units about the ranch. The distance from the ranch headquarters to the 60,000-acre range in Cherry county, Neb., leased for cattle grazing in the Nebraska national forest reserve, is about fifty miles by road.

An automobile, following the winding trail which traverses the badlands for a number of miles, requires fully two hours to make the trip. The plane makes it in from fifteen to twenty minutes.

From the ranch headquarters, men fly with saddles, branding irons and perhaps a spool of barbed wire, down into the hills of Cherry county where the Arnolds maintain a secondary base of operations, or else to a 4,000-acre ranch on the White river in South Dakota devoted to small grain, corn and hogs and rented out on shares. The plane makes an ideal conveyance for overseeing these widely separated activities, saving many days over the automobile method of transportation in a season's time.

Mr. Arnold considers the plane an absolute necessity in keeping track of cattle on the range. He has one pasture in Cherry county, consisting of twenty-eight sections of land. He runs 7,000 Hereford cattle, more than 500 horses and puts up over 5,000 tons of hay annually.

The Arnold plane also is frequently sent to Omaha, or to some point in Iowa or Colorado, to pick up and transport cattle buyers to the ranch when a quick turnover on cattle sales is wanted. Cody, Neb., fifteen miles from the ranch headquarters, is the nearest trading and shipping point and the plane goes to town regularly for mail and groceries in addition to frequent week-end trips to larger centers of population. Both Mr. Arnold and his son Eddie, a university student, fly the plane but a regular ranch pilot, Al Knutson, is employed to do most of the flying around the country.

Last winter when Frances, small daughter of the Arnolds, fell from her horse and fractured her skull, she was rushed by plane to Omaha and the fracture successfully treated. The surgeon declared that the speed and the absence of jar with which she was transported aided greatly in her successful treatment and quick recovery.

Leonard Kyes, a young ranchman, who with his older brother runs several farms in the Loup river country of north-central Nebraska, is another rancher who has used a plane for business as well as pleasure during the past two years. He owns a two-place biplane in which he makes frequent trips to Lincoln and Omaha, making the trip in about one-fourth the time required by an automobile.

Several times, Mr. Kyes has saved hours of valuable time when replacements were needed for some piece of machinery, such as a threshing machine. He finds the use of the plane so economical that he seldom uses an automobile any more, whether going to town, to a neighboring ranch or on a hunting or fishing trip. The ship is housed in a hangar which he constructed at a cost of $150 on the edge of a hay meadow adjacent to the house. The meadow serves very well as a private airport.

The plane is used regularly in looking after the Kyes herd of cattle.

## French Engineers Combine Autogiro and Plane

Side elevation of the new French "Clino-giro," a lifting screw type that has proved successful.

THE new "Clinogiro", invented by the French engineers Odier and Bessiere after several years of study, has at last taken to the air at the Guyancourt flying field. On its first trial it showed such remarkable performance as to suggest that it, or something like it, will be the final form in which the autogiro principle will be accepted in aviation circles.

It is a combination of the autogiro and an ordinary airplane, and what it does is a happy blend of the performance of both. Equipped with a 95 h.p. engine, the first Clinogiro made an average air speed of 108 m.p.h. in the hands of Pilot Henri Massot. This is a performance somewhat in advance of that of the full autogiro and in a series of exhaustive landing trials was able to descend at an angle in excess of 45 degrees with a dead engine. It came to a full stop in a space varying between 15 and 42 yards.

The first Clinogiro, a revamped Caudron C-193 low-wing monoplane, retains the wing surface of that machine and has a rather smaller and much stiffer rotor than the classic autogiro. Its full qualities can hardly be represented in figures, but may be best expressed by saying that it derives an almost perfect combination of flying qualities with the amount of power applied.

The lift and thrust given by a fixed wing are excellent at small angles of incidence, but poor at large angles. The whirling wing of the autogiro, though very efficient at high angles of incidence loses its efficiency rapidly at low angles. As a result, the autogiro does not glide well and has a comparatively short range of action.

But the Bessiere and Odier Clinogiro combines the qualities of both devices to some degree. Its lift at high angles of incidence is nearly three times that of the ordinary airplane and it has a radius of action much better than that of the ordinary autogiro. It also possesses the greater advantage of improved safety in landing. When an autogiro is taxiing after landing with the rotor still turning, the lift of the rotor causes the machine to have a weight of almost nothing; and as a result, it is peculiarly apt to be upset by a sudden gust. In the Clinogiro, the small size of the rotor does not give the machine enough lift to produce this "weightless" effect.

The machine is also said to be the first to make practical use of the gyrostatic effect. The four-bladed rotor is in reality composed of two long stiff propellers mounted on spherical joints and held in position by very heavy rubber bindings, which give the necessary rigidity for stability, and at the same time permits the rotors to have full play and do their work.

The necessity of experimenting with an altered machine, instead of building a new one, allows the rotor to be mounted in the place formerly occupied by the front cockpit. With the success of the trials at Guyancourt, a new Clinogiro is to be built, incorporating improvements suggested by the trials.

This machine is quite interesting in view of the fact that it contradicts the necessity of flexibility in the rotor blades—a claim long proclaimed by Cierva, the inventor of the Autogiro. Flexibility is not a desirable feature if it can successfully be avoided. By "flexibility" is meant, the ability of the rotor blades to move in planes other than in the rotation plane.

The achievement of a better gliding angle than is normally possible with the Autogiro is another distinct step in advance, for compared with the conventional airplane, the gliding angle of a helicopter type is decidedly poor.

This type of machine is in its infancy and it is difficult to forecast what the future will bring in the way of machines supplied with a lifting helix.

## Windlass for Start of Gliders

THE sport of gliding is popular in France. Usually gliders are started by towing by several men, but this is hard and tiring work. Flights on level ground are almost impossible.

One ingenious Frenchman, M. Magon, has invented a windlass that is very interesting. This system is now being used extensively in most French gliding clubs. Excellent results are being obtained at present.

The windlass can be adapted upon all motor cars of at least 12 h.p. It is composed of a drum mounted on the jacked-up rear wheel of an automobile.

The cable is wound on the drum and then passes over a pulley fastened to the front wheel. This makes it possible for the man controlling the towing to be able to see the glider at all times, thereby being able to prevent many accidents.

An ordinary towing cable is used, the length depending on the room available and the weight of the glider.

During the first five hundred flights after the idea was first used, there was not one failure. Since then the device has been used with great success in the training of new gliders. There is practically no wear on the car, unless a glider should accidentally crash into it.

## Plugs Prevent Fires

TESTS just completed by the National Advisory Committee for Aeronautics show that by use of a pack or plug of alternate flat and corrugated plates of thin metal installed in the intake pipe of a gasoline engine, all dangers of backfires reaching the carburetor may be eliminated.

## The Zoo Takes the Air

THIS picture, out of the long ago, shows Glenn Martin giving preliminary flight instruction to his baboon friend and student. Time, 1911. Place, Dominguez Field, Calif. Plane is an early type pusher.

We might name this, "his first solo."

# Sample of Transport Pilot's Exams.

Authoritative answers to the sample Transport Pilot's examination questions issued by the Department of Commerce, Aeronautics Branch.

## PART II

EDITOR'S NOTE. These answers were carefully compiled and approved by the technical staff of POPULAR AVIATION.

**Q. Give six things you would check in examining a weather map before making a cross-country flight with pay passengers.**

A. (1) *Wind direction,* (2) *Location of low pressure areas,* (3) *Whether raining at destination,* (4) *Temperature,* (5) *Wind velocity,* (6) *Ceiling.*

**Q. In what places in the United States is fog most prevalent?**

A. *Along eastern coast and near large bodies of water.*

**Q. What is the Beaufort scale?**

*showing how to judge the wind velocity*

A. *A series of diagrams or a scale by observing the effect of the wind in raising clouds of dust, moving the twigs and branches of trees, flapping flags or acting on smoke columns.*

**Q. What would cause excessive downdrafts in certain localities?**

A. *Large woods or forests, large bodies of water, ploughed fields.*

**Q. What causes ice to accumulate on the surface of an airplane while in flight at low altitudes?**

A. *If the dewpoint and relative humidity are almost the same ice will form on the wings due to the lowering of the pressure (and temperature) adjacent to the wing surface. Ice usually forms on leading edge.*

**Q. What are the chief constituents of the atmosphere?**

A. *Oxygen, nitrogen and carbon dioxide.*

**Q. What is a cyclone? An anti-cyclone?**

A. (1) *Cyclone is a severe low pressure area* (2) *Anti-cyclone is a high pressure area.*

**Q. (1) What are the approximate rates of travel of high and low pressure areas? Does this rate vary with the season of the year?**

A. *400-600 miles per day. Travel faster in winter than in summer.*

**Q. What cloud formation generally brings rain?**

A. *Nimbus.*

**Q. What is the source of information on the weather maps?**

A. *The United States Weather Bureau.*

**Q. What are the principal meteorological elements?**

A. *Temperature, pressure, precipitation and clouds.*

**Q. Why is it dangerous to fly close to thunder heads?**

A. *Because of the tremendous turbulence of the air at this point, the high velocity vertical currents and the danger of hail.*

**Q. What time of the year are thunder heads most likely to be seen?**

**This is a close-up of the "Robot-pilot" which flies the ship automatically and relieves the pilot.**

A. *In May, June and July.*

**Q. What is the dew point?**

A. *The temperature at which the moisture in the air starts to condense and produce droplets of water on a bright smooth surface.*

**Q. How is the velocity of the wind determined?**

A. *Precisely by an anemometer. Approximately by the Beaufort chart.*

**Q. What is the proper name for the rain cloud?**

A. *Nimbus.*

**Q. What is the stratosphere?**

A. *A region about ten miles above the surface of the earth at the equator which diminishes to about 2.5 miles at the poles. In this zone, the temperature remains constant at almost any point and the sky and surroundings appear perfectly dark unless struck by the direct rays of the sun.*

**Q. Explain the principle of the aneroid barometer.**

A. *It consists of a hollow exhausted vessel covered by a thin corrugated flexible metal diaphragm. When variations take place in the atmospheric pressure, this diaphragm moves correspondingly and its movements are communicated to a pointer and dial by a multiplying system of levers.*

**Q. What does a cumulus cloud look like?**

A. *It is a dazzling white heaped up mass of cloud of general conical form, pointed at the top and with a broad flat base.*

**Q. Define meteorology.**

A. *Meteorology is the science of weather conditions.*

**Q. What is necessary before condensation can take place?**

A. *Either a sudden reduction in temperature, a sudden reduction in pressure or both.*

**Q. What is a theodolite?**

A. *An instrument used for measuring distances.*

**Q. What is a fracto-nimbus cloud?**

A. *It is a low ragged torn shred of the black nimbus cloud, generally blown along rapidly, by a high wind.*

**Q. What is a mercury barometer?**

A. *A glass tube containing mercury, the columns of mercury being supported by the external pressure of the atmosphere. The height of the mercury above the basin indicates the atmospheric pressure and is measured in inches or millimeters.*

**Q. Under what type of cloud is the upward current of air generally the strongest?**

A. *Generally, under the cumulus couds although it sometimes reaches its maximum strength under the thunderhead or cumulo-nimbus cloud combination.*

**Q. Is this upward air current strong enough to be noticeable?**

A. *Yes. It is sometimes strong enough to support an airplane or glider without the assistance of the engine.*

**Q. Why is the air bumpy over large cities?**

A. *Because of the upwardly deflected air currents caused by tall buildings.*

**Q. Do clouds ever come up against the surface wind?**

A. *Yes. For example, the clouds may be moving south while the direction of the surface wind is north.*

# PRACTICAL MECHANICS SECTION

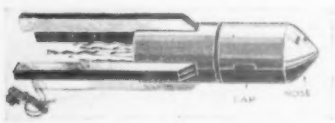
## Odds and Ends From Here and There

Brevities of interest and practical use for the amateur mechanic and experimenter

### Making a Display Rocket

THE BEAUTIFUL display rocket, illustrated in the photo, is made entirely of discarded metal pieces. The height is approximately thirty inches. The body is built of brass tubing or sheeting in circular form. The nose is a discarded shell of an automobile lamp. The legs or fins are built of square brass tubing.

The entire unit is soldered together, except the cap, which is removable and nickel plated. One-half of the entire



The completed rocket—looks like a real one.

unit is painted black and the other part remains bright nickel.

The port holes are cut into the lamp head and an electric light is placed inside. To put a realistic touch to the unit, a small fan is placed on the inside, which blows through a discarded section of a radiator shell, placed on the under side of the rocket, to which are attached thin silk streamers.

In operation, the light flashes in the nose of the rocket and the fan blows air out to the rear, making the streamers flutter, giving the effect of motion. This particular model won a $100 prize, given by a Chicago Department Store, and is now on display.

### There Ain't No Such Animal

HERE'S an animal that even Barney Google would envy. The nag doesn't run very fast.

The legs are made of pipes and the body seems to be made of a discarded tin drum.

Almost a nightmare, one might say, but it is really only a collection of old junk.

### Real Dumbells

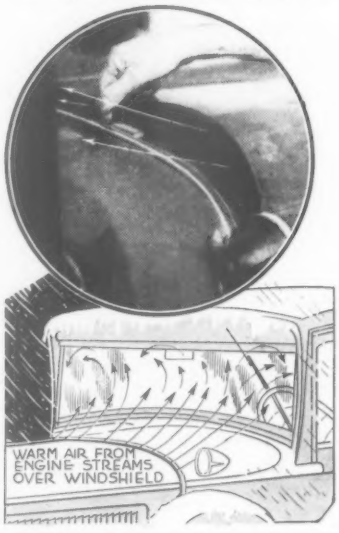
THOSE interested in developing their muscles will be interested in building this set of bar bells.

The set can have the same weight and appearance as a purchased bell with small cost.

The nearest second-hand machinery shop will supply the weights which are nothing more than counterbalances taken from a Cornice Break machine used in banding sheet metal.

The weights already have a hole bored in them, about a 1½-in., as well as a tapped hole for a set screw. The counterbalances can therefore be readily slipped over a ¼-in. standard pipe and held securely to form a perfect bar-bell.

### Keeps Windshield Clean

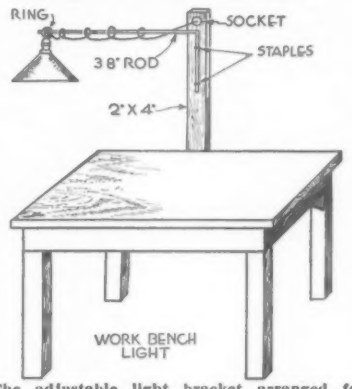



Showing how the warm air from the engine can be used to melt snow and frost on the windshield.

THE simplest device imaginable for keeping ice and sleet from collecting on the outside of windshields, or frost from forming on the inside, consists of two small wood blocks. When you encounter ice- and frost-forming weather, simply stop the car, loosen the hood catches, and place one block under each section of the hood, at the rear so that there is a narrow crack between the hood and cowl.

Hot air from the engine comes out through the crack and strikes the windshield, preventing ice and frost. You can fasten both hood catches, or only those at the front. Blocks measuring about ½x1x1½ in. are large enough.

### Light Bracket for Shop




The adjustable light bracket arranged for the work bench.

WORKING in the shadow is a bother, but not as much trouble as adjusting a poor light fixture. Here is one that is easy to adjust and easier to construct.

The bracket is an old brake rod bent at right angles and fastened with staples to the wall, or a 2x4 secured to the back of the bench. This bracket should be long enough to swing over the entire bench. The light slides on the rod to a ring that is a standard electric fixture.

Three or four turns of the light cord around the bracket take up the slack. Without looking up, the worker can swing the bracket or slide the light on it with one hand to eliminate shadows on any portion of the bench.

### Black Ray Now Used

THE "black ray", a beam which triples the intensity of radium-treated surfaces, but which is invisible to the eye, was demonstrated yesterday in American Airways' blind flying ship at the Newark Airport.

The device, which consists of two gadgets resembling tiny automobile headlights, is stationed in back of the pilot and the beams are focused on the instrument panel. It has no effect on material other than that which has been radium-treated, with the result that glare is entirely eliminated.

The "blind flying" ship is usually a former mailplane, rigged so that the rear cockpit is totally dark, and is used for instruction in blind flight.

Usually, the filter consists of quartz glass, for quartz glass is a filter that allows the ultra violet rays to pass and stops the rest of the visible light.

# An Easily Made Enlarging Camera

**An excellent enlarging and copying camera can easily be made from your present focussing type hand-camera—according to the following instructions.**

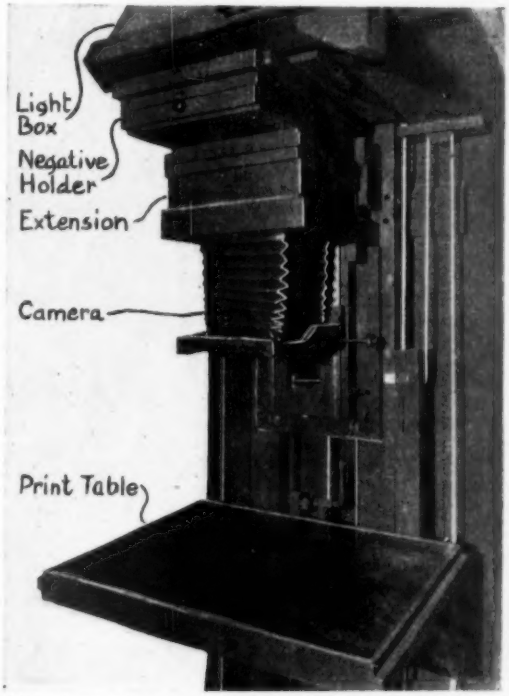
AMONG the photographic equipment which Admiral Byrd took with him to the South Pole was a little camera that takes a picture only one by one and a half inches in size. From these tiny negatives, however, he was table to make good lantern slides or prints eight by ten inches in size.

The tendency, today, among those who take up photography seriously, is to use smaller and smaller cameras and to depend more and more upon enlarging the pictures taken.

If one possesses a focusing camera, that is, one with a bellows, that can be moved out and in and fastened in place, all that is necessary to make an enlarger is an extension on the back of the camera, a source of light, a negative holder, a support and an easel on which to place the paper. The construction of the enlarger is comparatively simple and need cost but little money.

The first step, however, in building an enlarger is to figure out the dimensions. To do this figuring we must know the approximate length of focus of the lens, the size of the enlargement we want to make and the controlled movement of the bellows on the camera to be used. From this data we can determine in advance the exact dimensions of the enlarger.

The focal length of the lens is usually given in the catalogue of manufacturer and should be marked on the lens mount. On the lens mount, however, it may be given in millimeters rather than inches. For example, the lens on my post card size kodak is marked, f 6.3, 170 m.m. This means that the lens can be used at an aperture or speed of f 6.3 and that it is of 170 m.m. focus. Since an m.m. is equal to .03937 of an inch, I multiply 170 by this decimal and get 6.6929 inches which is approximately 6¾ inches which is given in the catalogue as the focal length of the lens. If there had been no other way of finding the focal length I would have set the camera at infinity, that is, moved the lens back till the pointer came to infinity and then measured as closely as I could the distance from the lens front to the back. This gives me approximately 6¾ inches.



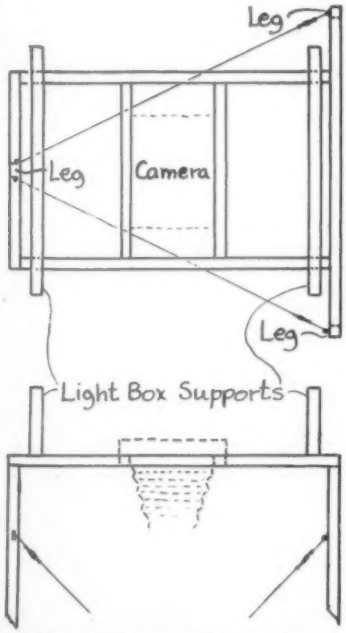

The enlarging camera completely assembled and ready for enlarging copy on print table.

Now that we know the focus of the lens we can start the actual figuring of the dimensions of the enlarger. The distance between the lens and easel in making an enlargement is the focal length of the lens multiplied by the times of enlargement plus one. The distance between the lens and the negative is equal to the distance between the lens and the easel divided by the times of enlargement. Making up a table for the post card size kodak we get the following results:

The "add. extension" is the distance that will have to be added from the back of the camera to the negative holder in order to secure sufficient distance between the negative and the lens. Right here we run into another limitation in the use of our camera for enlarging purposes. This post card size kodak has a controlled bellows movement of only ⅝ inch.

In the case of this particular camera the front can be clamped to the rail in any position but the focusing movement of the rail is only ⅝ of an inch. Let us assume then that we are working with a camera that has only this movement of the lens. Some small cameras have only a few points where the focusing arrangement can be locked.

Suppose we want to make an enlarger with this post card size camera, using only the ⅝-inch focusing movement and disregarding the fact that the front can be clamped to different parts of the rail and that we decided that we want the enlarged picture 8 inches on the short side. This gives us about a 2½ times enlargement. We will have to have an extension about 2½ inches on the back. We now have

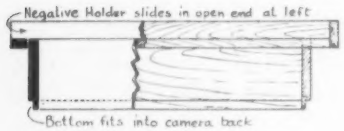



Sketches of the supporting members.

| *Times of Enlargement* | *Lens to Easel* | *Lens to Negative* | *Add. Extension* | *Easel to Negative* | *Size of Enlargement* |
|---|---|---|---|---|---|
| 1 | 13½ | 13-1/2 | 6-3/4 | 27 | 3¼ x 5½ |
| 1½ | 16⅞ | 11-1/4 | 4-1/4 | 28⅛ | 4⅞ x 8¼ |
| 2 | 20¼ | 10-1/8 | 3-3/8 | 30⅜ | 6½x11 |
| 2½ | 23⅝ | 9-9/20 | 2-7/10 | 33 | 8⅛x13¾ |
| 3 | 27 | 9 | 2-1/4 | 36 | 9¾x16½ |
| 3½ | 30⅜ | 8-19/28 | 1-26/28 | 39 | 11¾x19¼ |
| 4 | 33¾ | 8-7/16 | 1-11/16 | 42 | 13 x22 |
| 4½ | 37⅛ | 8-1/4 | 1-1/2 | 45⅜ | 14⅝x24¾ |
| 5 | 40½ | 8.1 | 1.45 | 48.6 | 16¼x27½ |

the data we need for going ahead with the enlarger.

THE first thing to do is to build the extension for the back. Take off the back of the camera and with thin wood make a box-like extension with top and bottom open that fits into the open back of the camera in the same grooves that the regular back fits. In this case the top of this will be just a little less than two and a half inches from the rolls over which the film is wound. Boards from empty cigar boxes cut to the proper shape and dimensions and glued and then nailed together with small brads serve the purpose well. The portions that fit into the back of the camera will have to be planed down thin enough to



Detail of negative holder.

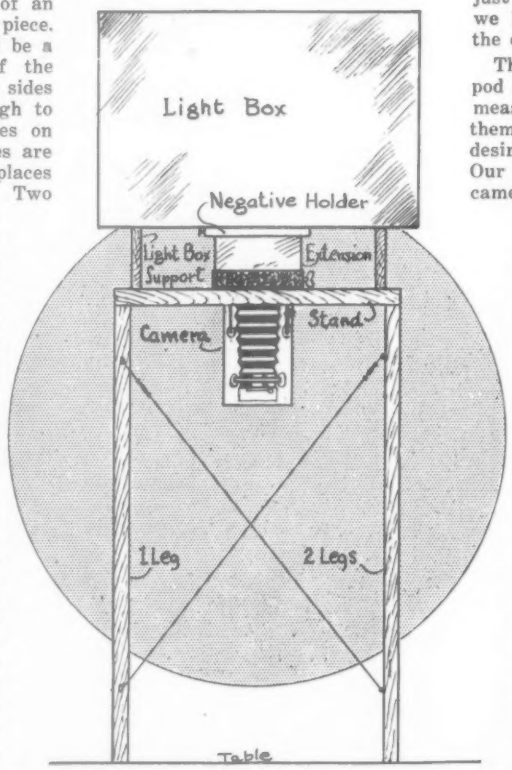
slide in. Nail cleats around the outside of the top to hold the negative carrier.

The negative carrier consists of a frame made up of four or more pieces. An easy way to make this is to again use pieces of empty cigar boxes. Each side of the frame is made up of two pieces, one placed above the other and the top pieces about an eighth of an inch narrower than the lower piece. The opening in the frame should be a little greater than the size of the negative. The top piece of two sides of the frame are cut long enough to nail and glue to the lower pieces on the other sides. The other pieces are then fitted into their proper places and glued and nailed in place. Two clear sheets of glass now have to be cut to fit into the frame. The lower members of this frame serve as a support for the glass and the upper members hold the glass in place. When this frame is placed on the cleats at the top of the extension and the extension is placed in the back of the camera, the distance between where the film would be in the camera and the upper level of the lower piece of glass should be 2½ inches.

Now nail pieces of board on three sides of the extensions nailing them to the cleats at the top and have them wide enough so that they extend up a little above the negative carrier, when it is in place. Plane down three sides of this carrier so that it slides easily into this space. Nail a board over the end of the negative carrier at the side where no board has been nailed to the cleat on the extension. This should match up and fit to the boards that have been nailed to the cleat. A screw eye screwed into this front of the negative carrier will serve well enough as a handle.

The extension and negative carrier are now nearly completed. However, it is probable that they leak light and the next step is to get some plastic wood and fill in all the cracks and holes. It is a good idea to place the extension in the back of the camera, take some strips of paper, lay them along the camera back outside the extension, to protect the camera itself and then build up a small moulding all around, fitting tightly against the camera. This is easy to do with plastic wood and makes a light-tight job, even though the workmanship on the extension has not been perfect. After the plastic wood becomes dry and hard, give the extension and negative carrier one or two coats of dull black paint. Glossy black paint should not be used.

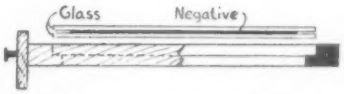
Our next job is to build a support for the camera and light box. If we are going to make but one size of enlargement the support may well be just a frame work that will support the camera at such a height that the negative when it is in the carrier will be 33 inches above the table top when the camera is placed upon the frame. The legs of the frame ought to be for this enlarger about fifteen inches apart and it is better to have only three legs so that all will stand firmly on the table top or whatever else is used as an easel.



Front elevation of completely assembled enlarging camera showing relative positions of stand, camera, extension, light-box support, negative holder and light-box standing on the table.

This frame work is made of wood that measures approximately a square inch in cross section. It can be made of lighter pieces but as it has to support the light box as well as the camera it is well to have it strong enough. Two pieces are cut that are just a trifle longer than the back of the camera and two others that in this case would be 15 inches long. Placing one of the 15-inch pieces beside the back of the camera so that the center will be in the center lines of the camera we now carefully mark off a distance at each side that just clears the bellows space.

The two short pieces are then nailed to the long one, each piece just touching the mark. The other piece is nailed to the other ends of the short pieces in the same way. Now the camera can be placed through the



Detail of the camera extension.

opening but the short pieces will come up against the back and serve as a support when the frame is completed.

Another short piece is nailed to the ends of the long pieces at one end and another piece fifteen inches long will be nailed to the ends at the other end. This last piece should extend just as far to one side of the frame we have already made as it does on the other.

The next step is to attach the tripod legs to this frame. As very exact measurements will be required to get them the exact length necessary, it is desirable to have them adjustable. Our table of data shows that for this camera the distance from the easel to the negative needs to be 33 inches. Therefore, we measure as accurately as we can the distance from the negative carrier to the bottom of the frame when the camera is in position. We deduct this from 33 inches and make our legs a little shorter. These legs are attached at the end of the long cross piece and in the center of the short piece, thus forming a tripod. Steel brackets can be used to make them firm and rigid.

A simple way of correcting the length of the legs when the apparatus is in use is to have sets of small blocks of wood of different thickness that can be placed under the legs to lengthen them. If the camera has rack and gear focusing arrangement, this will do nicely. If it is a camera where the lens is pulled out and locked in notches, it may require some experimenting to get the legs just the exact length necessary for a sharp focus.

# What Our Readers Are Building

A department devoted to our readers' activities in airplane, glider and engine construction, showing the latest developments in the amateur field.

## We Are Getting Lots of Dope

THIS time we are most happy to announce we are literally wading knee-deep in photographs of our readers' productions. Therefore, the readers of this department are assured of plenty of material for this issue and the next issue at least, but this does not mean that our contributors are to lay-off sending in letters or photos. Nay—nay, just send them in now while you happen to think of it so that the editor will not have gray hair in his scalp 60 days hence.

In this number, we have the extreme pleasure of printing a long letter of one of our readers who not only built his ship but who designed and built the engine as well. If there are any more engine designers and builders, we would be glad to hear from them. The number of fellows who have the ambition and nerve to tackle the engine problem are far and few between.

## Comfortable Airplane Seat

WITH A FEW old tin cans, some padding and a piece of tapestry or mohair, a very useful light seat can be made in a short time.

Old cans make a good seat for lightplanes.

## New Pietenpol Looks Fine

HERE we have a view of the latest Pietenpol production—Ford "A" powered. The designer, B. H. Pietenpol, says that it has a speed of 85 m.p.h. over a 10 mile course and that is moving some for a light plane.

Here is the new Pietenpol ship.

## The New Corben Baby Ace

The sleek lines of the new Corben "Baby Ace" so successfully built by Perry B. Dunn.

THIS trim single place Corben Baby Ace cabin sport plane was built by Perry B. Dunn of Omaha, Nebraska. Powered with a Salmson 9 cylinder radial engine developing 40 h.p., this little ship won third place in the 275 cubic inch displacement race at the Omaha Air Races this summer, which goes to prove it may be a baby in size but an ace in performance.

In addition to getting in on the prize money, Mr. Dunn advises that the ship won more than its share of attention due to its small size. The wing spread is 27 feet from tip to tip and the entire length of the ship is 17 feet 5 inches. The gasoline consumption is only 3 gallons per hour at 85 m.p.h. cruising speed, making the operating cost about half of the average light car. The ship is equipped with air wheels in addition to the regular shock struts.

## Violations in 1932

THE Aeronautics Branch of the Department of Commerce dealt with 268 violations of the Air Commerce Regulations during the second quarter of 1932.

During this quarter, the Aeronautics Branch collected civil penalties to the amount of $1,025, of which $150 applied to penalties assessed during this period.

Civil penalties were assessed against 44 persons during the second quarter of the year. Also 31 reprimands, 106 suspensions, 23 revocations and 15 denials of licenses were imposed for violations. In 49 cases, evidence was produced which justified dismissal of the charges.

There were 45 violations of the acrobatic clause. Other specific violations during the first quarter of 1932 were: Low flying, 33; unlicensed pilot flying licensed plane, 33; flying at night without position lights, 6; flying without identification numbers, 2.

Now that most of the state laws are in force, restricting aviation, we will see whether the home-built planes have contributed to the accidents. We hardly believe that there will be enough difference to be noticeable.

## A Novel Secondary Glider

A glider with a Heath body.

M. G. WESLEDER, with three of his friends, built this nifty looking secondary glider according to the plans of Al Schermerhorn. The fuselage is a Heath parasol part, while the wing is a government approved structure of 40-foot span and 5-foot chord. The assembly and general design are original and some desirable ideas are incorporated in it.

For example, the leading edge is stiffened with galvanized iron screening instead of plywood, for it was found that the screening conforms more easily to the shape of the wing.

## "The Suicide Buggy"

Here is the "Suicide Buggy No. 1" ready to be towed out to the field for test.

HERE is a letter from one of our enthusiasts, George W. Jones, 924 Camp St., Indianapolis, Ind. By the time this appears in press, he and his pals will know whether she will or won't.

*Dear Ed:*

*I am the same little colored fellow who wrote to your mag a short time ago, just to get acquainted with the P. A., which I think is a very good mag. I work for an Indianapolis undertaker although I prefer aviation and expect to make it my life's work if I ever get into it.*

*I have been reading your builders' column ever since it started, and here is what I am sending in.*

*I built every inch of her, with the aid of my two pals, she has a 28 foot span and a 5 foot chord. The fuselage is 17 feet long, and 22 inches wide, and she stands six and one half feet tall. The crate weighs four hundred and fifty pounds.*

*We have her figured out to do a hundred and ten m.p.h., and we are all through and ready to put her together at the airport for the last time.*

*We are hoping to send you a photo of our little ship in flight real soon, the accompanying ones were taken during construction.*

And he has given a most striking name to this production — "Suicide Buggy No. 1". We certainly hope that it will not turn out as bad as that.

## Lubrication is Important

MOST amateur engine builders and rebuilders, generally neglect the proper layout of the lubrication system which is one of the most important parts of the engine.

Pressure feed is imperative and the pump must be designed to supply the oil at a high pressure. Ducts and passages must be large to avoid clogging and must be secured against leakage due to vibration.

## Fred Krug Proves a Hero

ON JUNE 16th of last year, I think that record was made. A record, perhaps, that will be hard for some people to believe. To begin right I will introduce myself. My name is Wallace Sanders. I own a Moth Biplane.

While on a visit to Jersey, last year, I met and made friends with a young fellow by the name of Fred Krug. It seems that he had just received his Student's permit and was waiting for his cousin Bobby Buck to begin teaching him. He had been given a ride to the Teterboro Airport by a friend in a car and was killing the day hanging around "ground flying".

I landed at the field a total stranger, and seeing the young man, walked over and asked him the direction into town. It seems he knew about as much about the place as I, so we united in our search for information. After about a half hour of asking questions and receiving grouchy directions, we found ourselves in a small lunch cart.

We ate and parted the best of friends. On the way back to the field, Fred proudly showed me his flyer's permit and jokingly asked me for a lesson. I took him up on it and we both headed for my plane. It was some time before the plane was ready, for we had to have the dual controls set and the ship serviced first.

Finally, all was set and we climbed into the plane. He seated himself in the rear cockpit and I sat in the front. All went fine. I took him up and taught him gentle turns, the lesson lasting 15 to 20 minutes. That was all. I did not teach him landing or taking off.

I signaled him to let go the controls and proceeded to stunt. After doing a few loops, I banked to swing back to the field and suddenly felt myself growing dizzy. I turned to motion Fred to take the controls before I became too dizzy and lost control when I went out. I must of just fainted away. The rest of the story I will tell in the words of Fred, when after the experience, I asked him what he did.

"When I saw you turn and motion to me, I thought you wanted me to try a few more banks. I adjusted myself and was just about to try and put her through the maneuver you taught me, when I saw your arm fall and you kind of slid down in the cockpit. I was awfully scared—I thought you had died.

"My hand was on the stick and I didn't notice that mine was the only hand now keeping the ship in flight. Your hand luckily fell off the control stick. It was a few seconds before I realized that I was some 1200 feet above earth and none but me to take the plane down to a landing. I was scared. I ran up a cold sweat and swung the ship around, hoping you would come to if I gave you time.

"I circled the field a couple times, always losing a little altitude. You did

(*Continued on page* 198)

## Builds a Lincoln Sport Model

Side elevation of Lincoln Sport model.

NOW, out in Wall Lake, Iowa, lives Levern P. (Slim) Kowalke, who has built himself a mighty neat looking Lincoln Sport plane. He has made several changes from the regular design which consist of a welded steel fuselage, welded tail group and "N" struts instead of the original "I" struts.

When powered with a three cylinder 35 h.p. Anzani, Slim says it is a hot performer—fast and climbs like a pursuit ship. He sold the engine last spring and would also like to sell the ship for $100.00.

This Lincoln Sport is a clean job all around.

## Here Is a Home-made Heath

AND next we hear from Tennessee. W. N. Allen of Bemis, Tenn., has recently completed a Heath Parasol, Model L. V., that was largely constructed from materials purchased from the Heath Company. He followed the Heath plans exactly, except for a few minor changes recommended by the inspector. He is very much pleased with the job and would like to hear from other Heath owners.

He says that the ship is a real performer with a cruising speed of 70 m.p.h., landing at 35 m.p.h. It is powered with a 30 h.p. S. B. Henderson De Luxe engine that turns a five-foot propeller at 3,100 r.p.m. in the air. It has a full set of instruments, semi-air wheels and is covered with Flitex throughout. He would like to sell or trade, as he now wants a larger job.

W. A. Allen and his Heath Model L. V.

# Reader Builds Engine, Plane and All

*by* GLENN W. BERK

A highly interesting letter from one of our readers who tells how he designed and built both the engine and plane described below, and who taught himself to fly. This should be an inspiration to other readers who hesitate tackling the job.

Dear Editor:—

I suppose every P.A. reader, especially the home plane builders are as much interested in the P.A.'s builders column as I am, no matter how homely the pictures are. So I decided I would send you a few snapshots of what I have done and am still doing.

The plane in the picture is of Storm's specifications changed somewhat to suit my own fancy. Wish I were building it all over again with the experience I have gained. I sure would build it modern. It is interesting to note that three and one-half years ago, when I first started to build this plane, it was about the only high-wing parasol type plane of this size that I knew of.

Everybody complimented me on how homely it did look, but today it has become quite popular for now they are hanging the wings still higher. I believe I bought about the first set of blueprints that Storms made for I received them piecemeal fashion. I knew nothing of aviation before nor how ignorant I was of it.

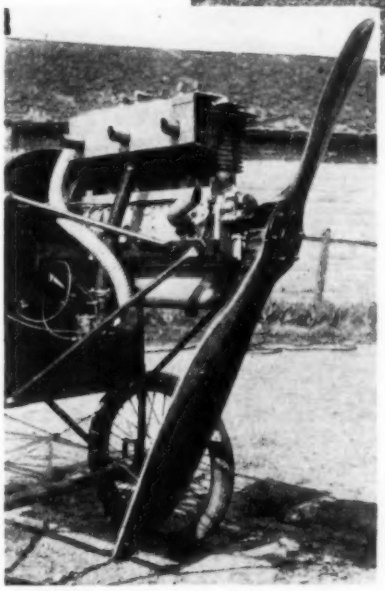
I did have shop experience and a good shop which was a great help to me in building my plane. The past three years have been like a school in aviation to me, having rebuilt a couple of crackups, converted several car motors for aviation use and designed an engine myself (I guess that's the reason it wasn't quite a success) of which I have enclosed a picture.

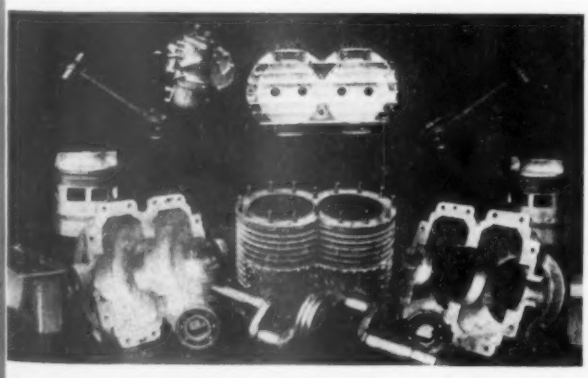
It weighs about 80 pounds and develops as much power as a model "T" Ford engine. In fact, it is designed around a Model "T" crankshaft and connecting rods to cut down expense, but because of the depression I have just laid it aside for the time being. The two largest bugs it had were inefficient cooling and and poor idling. Think I can whip that in my next attempt.

Well, getting back to the plane's history again, which I cannot take time to tell you here, for it has quite a history. It has never been cracked-up but came very near it with amateur flyers. I used a 1923 Star engine of 3⅛" bore and air-cooled it which was a sure enough job. Had a cylinder head cast of aluminum with radiating fins. This engine has given wonderful service due mainly to its good oiling system.

**At the right is Mr. Berk's completed ship in flying order. A clean cut job.**

**Below we see the engine mounted in place on the engine bearers.**





**The Berk engine dissembled showing the simplicity of the engine and the few parts required.**

We have tried out several propellers on this engine, all of which we have made, to find its best performance. The first one we made performs about as well or better than some of the others, but was broken the day we celebrated the first flights.

With all of my enthusiasm in aviation, I have never been up except five or six times before this last spring and never had a field large enough to taxi my single-seater until last spring I secured a field one-half mile in length.

I began hedge-hopping, taking-off and landing without leaving the field, until I would get an altitude of about 75 to 100 feet and land at the end of the same field .

Got so I could make a 3-point landing that a transport need not be ashamed of. With this 65-mile-an-hour plane this was a lot of fun and mighty good practice. We did this maneuver until I was satisfied I was ready for a solo. You can imagine the thrill I got the first time I left the field one calm evening, May 17, all alone and made a sensible "figure-8" over the field and came in with a fine landing.

Why, I dare say that Lindbergh didn't experience a greater thrill when he started for Paris. Was up fifteen minutes on my first solo. I didn't make any vertical banks on that trip and haven't yet at this writing. Up till now I have made six flights, a total of two hours. I am now 39 years of age, and not saying it boastfully, I feel that I have made splendid progress for not having taken any time whatsoever on another plane.

I do not advocate self-taught flying, yet some of our oldest fliers have done that very thing. With the right type of plane, a large field and a little common sense, one can very easily learn to fly if adapted to it, by taking his time at it just as easily as a child learns to walk. One thing, a fellow has to be sure of his steps. Well, it's fine sport and I enjoy it very much.

POPULAR AVIATION subjects are of intense interest to me and I always look forward from one month to the next to get it. I purchased a Lincoln Page 3 crackup last fall and have rebuilt the fuselage with modifications on the tail group, also putting double ignition on the OX5, and am about ready to start construction on the 44-foot monoplane wing (U. S. 35A section) which I am going to use on the LP3 fuselage.

(*Continued on page* 199)

# ENLARGED MODEL DEPARTMENT

## New Ideas for Our Model Builders

New model building and flying stunts gathered from far and near for our readers.

### Low Wing Stick Model Monoplanes

ONE advantage of the monoplane wing being fixed underneath the fuselage instead of on top, is that when the model encounters a gust of wind it cannot fail to lift the model.

This does not always happen when the wing is fixed on top of the fuselage unless the rubber bands are tight enough to resist the extra strain imposed upon them. If they are not tight enough, the gust of wind tends to lift the wing off the fuselage resulting in stalling and consequent nose-dive.

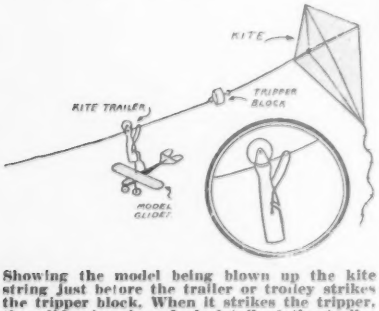
To test whether the rubber bands are tight enough, which cannot be observed when the model is in flight, hold the model by the wing, one hand under each side close to the fuselage and give it a jerk upwards. If the wing lifts from the fuselage the rubber bands need tightening up. This tightness is a strain on the longerons and becomes unnecessary when the wing is fixed under the fuselage.

### Boys! Here's a New Stunt

IF YOU want to get a good long distance glide from your model glider, it is necessary to get it up to a good elevation before starting the glide, and the best way to get elevation is by means of a kite.

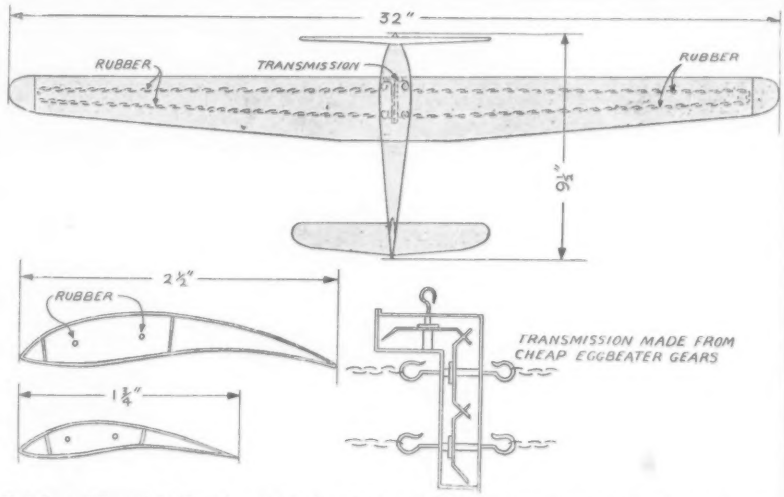
Now, this has been made very simple by the invention of Mr. Michael Syracuser, 1639 S. California Ave., Chicago. He provides a single wheeled carriage running on the kite string which carries the model while it is being blown up to the kite along the string.

When the glider gets up to the kite, it strikes a block which opens the trigger in the carriage so that the glider is released and starts on its glide. Pretty nifty, we think.




Showing the model being blown up the kite string just before the trailer or trolley strikes the tripper block. When it strikes the tripper, the glider is released. A detail of the trailer is in the circle.

### This Model Carries Its Motor in Its Wings



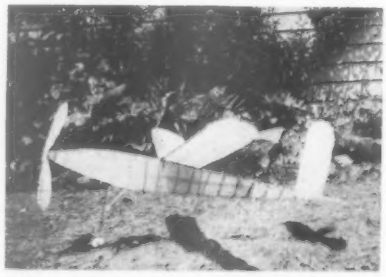

Details and layout of the wing-motored model in which the rubber runs from wing-tip to wing-tip.

AN unknown reader, whom we will be glad to hear from further, sends us this sketch of a novel model powerplant. By this arrangement, which is particularly well adapted to scale models, the length of the fuselage can be almost anything that we wish, regardless of the length of the motor stick.

As will be seen, the rubber from each wing tip runs to a transmission gear in the nose of the fuselage, the purpose of which is to turn the motion at right angles to the rubber.

It has the further advantage that the length of rubber can be made greater for a scale model than when it is located in the fuselage for the wing span is always greater than the length of the fuselage.

### Builds a Three-Foot Model



The three-foot model built by John Weiss.

JOHN WEISS, 151 Lathrop Ave., Westerleigh, L. I., N. Y., hereby presents a photograph of one of his excellent models. He has been building models for three years. The model shown here is a big one. It has a span of 37 inches, a length of 26⅞ inches and weighs two ounces.

It will be noted that this model has a very pronounced dihedral and that the chassis is unusually high.

### A Ford Airliner Model

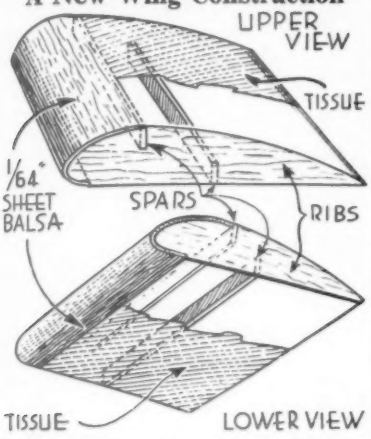
LOUIS L. STRAUSS, 1323 First Ave., So., Fargo, N. D., is progressive and keeps up with the times. He has just completed a very striking model of a Ford Airliner shown here, which is true to life. Originality in model building is to be commended.

It is unfortunate in a model of this sort that the rubber for the wing motors cannot be concealed. Maybe it could be put in the wings as in the diagram at the top of this page.

View of the Ford Airliner model which is complete in every detail.

# NEW MODEL KINKS BY OUR READERS

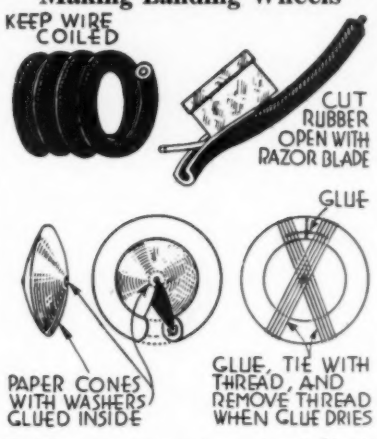
## A New Wing Construction




HENRY F. Cordes, Box 2, Hayward, Okla., submits a very ingenious wing construction which should prove useful to our readers. It does away with all intermediate ribs, only the two end ribs being necessary.

First, the two end ribs are cut to form and are then connected by means of the spars. The wing is then further reinforced by a balsa nosing of 1/64 inch sheet balsa glued in place. The tissue is now cemented to the nosing and ribs on both the top and bottom of the wing.

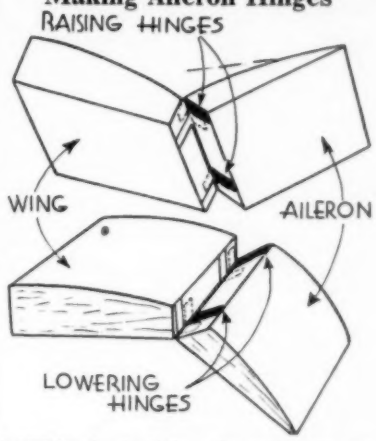
## Making Landing Wheels


KEEP WIRE COILED
CUT RUBBER OPEN WITH RAZOR BLADE
GLUE
PAPER CONES WITH WASHERS GLUED INSIDE
GLUE, TIE WITH THREAD, AND REMOVE THREAD WHEN GLUE DRIES

DID you ever want a pair of wheels in a hurry? Well, Lee Butler, 213 Sullivan St., Greenville, S. C., shows how you can make a neat wheel from wire insulation and stiff paper.

The wheel centers are two paper cones placed base to base. The tires are made from the rubber insulation found on electric wire. The wire is first coiled and the insulation is split with a razor blade. After the insulation is forced on the edges of the cones, it is cut off and is glued to the wheel.

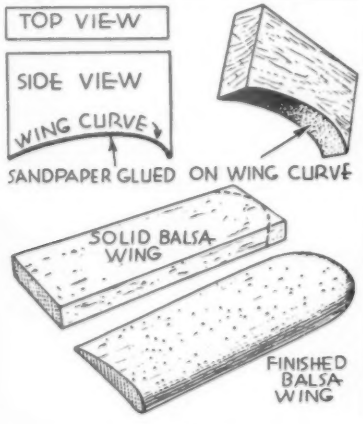
## Making Aileron Hinges




VERY simple light aileron hinges are suggested by Mr. Daniels, 2304 Vincent Ave., N, Minneapolis, Minn. These hinges are made from strong paper or cloth and permit the ailerons to be swung up and down with little effort.

Two of the strips are pasted at one end to the inner aileron edge and to the top of the wing at the other. Two of the strips are cemented to the edge of the wing and to the bottom of the aileron as shown.

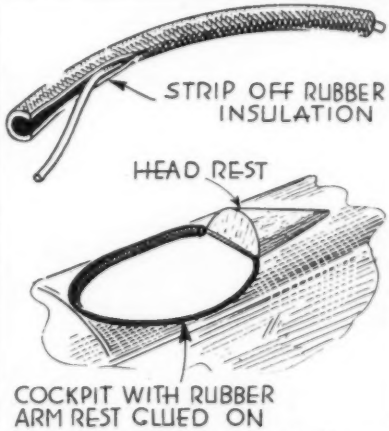
## Forming Solid Balsa Wings




A LABOR saving tool that will insure a good job when working down a solid balsa wing has been submitted by Wm. H. Bennet, 652 Second St., Fall River, Mass.

The tool is a sandpaper block, cut to the wing curve at one end. A piece of fine sandpaper is then pasted to this curved end and thus we have a cutting templet that will carve the wing accurately to form. The soft balsa is quickly cut when the templet is rubbed back and forth along the block.

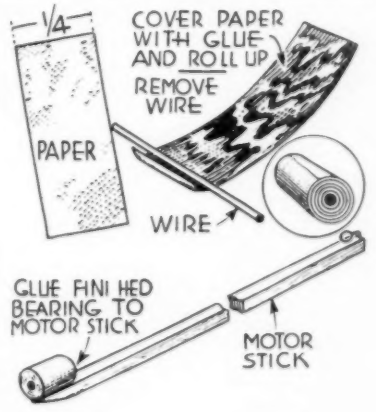
## Coaming for the Cockpit




FRED ROSELL, JR., R. R. No. 1, Centerville, Ohio, shows another use for the rubber insulation found on electric wires. This time, the insulation is split and is used for a coaming or padding for the cockpit of the model.

After the insulation is split with a razor blade, it is removed from the wire and is then glued to the cockpit opening as indicated in the drawing. When used on an O. C. model, his stunt adds much to its natural appearance. A very small rubber tube would also serve the purpose.

## A New Type Motor Bearing




A PROPELLER shaft bearing is very easily made by rolling up and glueing a strip of paper as shown by the accompanying sketch. This is the idea that brings Wm. H. Bennett a second prize and a second dollar.

The paper is covered with glue on one side and is then rolled up over a wire of the proper diameter. After drying, it is glued to the end of the motor stick as shown. Care should be taken to have the outer end square with the stick.

# Building a R. O. W. Pusher Seaplane

*by* POP STICK

*(See diagram on opposite page)*

Much pleasure can be had from this simple model which takes-off from and lands on the water—just like a big seaplane.

THIS month we present a seaplane, R. O. W. pusher.

Little, if any, attention has been given to hydro models, and by the results obtained from this design, we hope that the readers of POPULAR AVIATION will take this type of model up with enthusiasm and send in pictures which will be published. A few prizes are offered for the best ones.

1st prize—$5.00 in cash.
2nd prize—$3.00 in cash.
3rd prize—Year's subscription to P. A.

### Body or "A" Frame

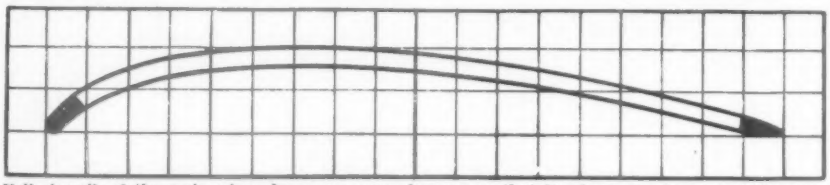
The overall length of the "A" frame is 30 inches and the long members are 3/16x⅜ inch in cross sections. The thin braces that hold the frame together at four points are cut from hard balsa 1/16 of an inch thick. The first one at the wide end is ¾ inch wide, the second is ½ inch wide and the next two are ⅜ inch wide.

These braces are fitted into a slot cut into the body members. At the point where they go through, be sure to wrap three or five turns of thin silk thread around each side of the brace which will prevent the long members from splitting.

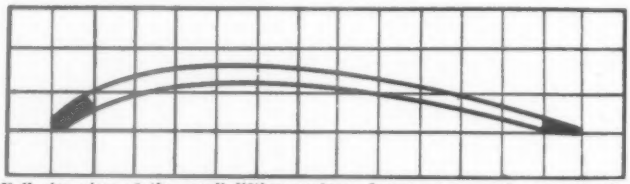
Cuts illustrating the correct wing curve are laid out in squares so that copying may be done easily and correctly. The ribs are 1/16 inch wide and ⅛ inch deep and cut to conform to the required curve. Covering is put only in the top side.

The large wing has a dihedral of 1 inch at each tip. The wing tips are round and made from bent bamboo. The size of this piece is 1/32 x1/6 inch. The drawing shows one wing tip with the covering cut away which illustrates how the bamboo is fitted into the spars.

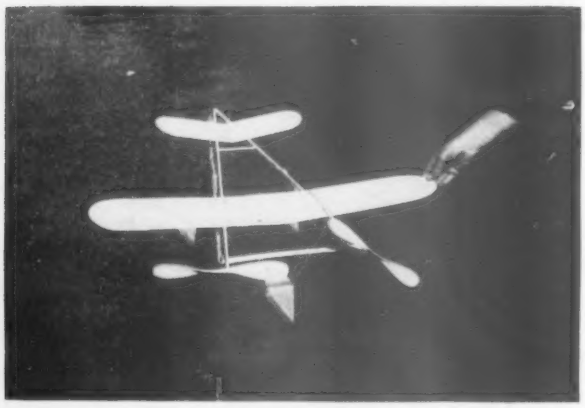
Side view of this interesting pusher type seaplane showing the relative arrangement of the surfaces, floats and twin propellers. It is flown from a small pond or lake where the water is glassy smooth or has slight ripples.



Full size rib of the main wing, drawn on squared paper so that its shape can be accurately reproduced. It is single surfaced with the covering placed over the top of the ribs only. Blackened areas represent the wing spars.



Full size view of the small lifting surface, drawn on squared paper so that its exact shape can be accurately copied. The accuracy by which this curvature is reproduced is important.



Rear view of the model in take-off position and resting on the water. This is a very successful model of the R. O. W. type.

The leading and trailing edges act as spars. The leading edge is round on the front and the portion between each rib is cut away towards the top to help streamline and allow the flow of air to pass without undue resistance. The front part of the trailing edge between the ribs is cut away in a similar fashion to help streamline between each rib.

The main wing is attached to the frame with rubber bands so that proper balance may be secured by moving it back and forth. The leading edge and trailing edge are made of firm balsa ⅛x¼ inch and cut to the desired shape illustrated on the rib drawing.

### Elevator

The elevator is built similar to the main wing, but the spars are a trifle smaller, namely ⅛x3/16 inch. The dihedral of this elevator is large, being equal to 2 inches on each side. This small wing is given an angle of incidence of 5/16 inch and is cemented at the position shown on the drawing. It is covered on one side only.

### Fittings

The following fittings are required and should be bent from tinned piano wire, size .029 inch. Two propeller shafts and the length from the edge of the propeller to the end of the curved hook should not be less than an inch and one-half. If this length is shorter, the propeller will have a tendency to wobble and by using a slight increase in length, not over the amount given above, this wobble or side swaying of

the propeller will be mostly eliminated.

Because of the strong frame members, only two anti-buckling eyes are required—one on each side half way down the length. Two "S" hooks and one "Y" yoke make up the amount of wire fittings required. Three washers are fitted on each shaft and two metal thrust bearings complete the set of metal fittings for the whole model.

The thrust bearings may be hammered from small nails or cut and drilled by using one-half of a cotter pin, having a diameter not over 1/16 inch at the most.

### Floats

Two pieces of bamboo are bent to the top view and then are held apart at the center by a small bulk-head with the lower frame coming up and meeting the top one as illustrated on the side view.

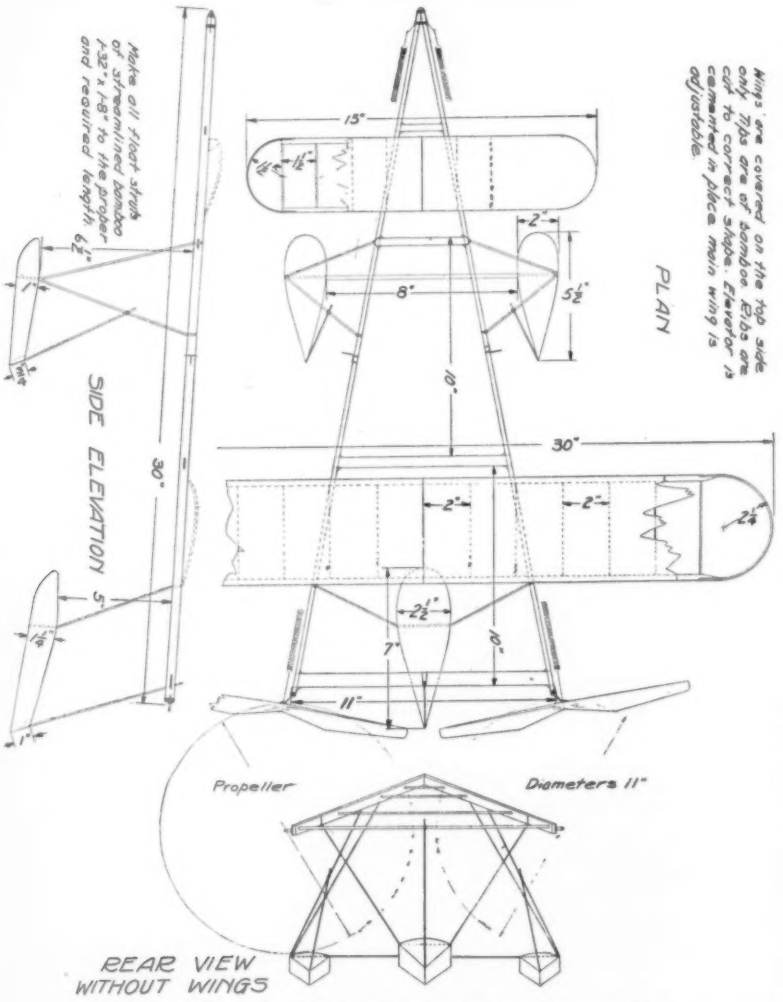
The rear end comes to a sharp wedge, which allows it to draw through and out of the water with practically no resistance. Note that the rear float is 2 inches longer and ½ inch wider than the front ones. Each float has a separate adjustment so that the angle may be increased or decreased to help the model leave the water quickly or to cause it to run over the surface for a distance of 7 to 10 feet. This adjustment is plainly illustrated.

On the side view, the upright piece of bamboo is held firmly against the rear float strut on the front floats and against the first cross member of the frame for the rear float. A small rubber band tied around the adjusting bamboo strip allows it to be moved up or down. All joints for the floats should be securely cemented and tied with three to five turns of silk thread.

The floats should be covered with a light bamboo tissue and given four to five coats of dope. Dope is not guaranteed to be waterproof, but is good enough so that the model floats will not absorb water fast enough to prevent them from staying above water for short periods, as sometimes happens.

### Motors

Eleven-inch propellers are carved to the conventional method as illustrated in the August issue of P. A.




Drawings of R. O. W. "Hydro-Sky Flyer" Seaplane (See page 186).

## Twenty Years of Flying

TWENTY years ago Capt. Robert J. Stewart first took to the air in a glider. Now he has taken to the air in another way—by radio—to tell the world of the advancements that have occurred in aviation during his twenty years of flight.

At that time Stewart was a youth highly intrigued by the newly discovered art of flying. He and a boyhood pal, W. Overton ("Snits") Snider, now a division engineer for Pan American Airways in Miami, built a glider that each flew tied on behind a chugging motorcycle. This was great adventure for a time, but it was not enough, so Stewart built a flying boat and powered it with two imported French motors, the best aircraft engines of that day.

Now let him tell his story as he spoke it into the air over Station WFBR:

"We used bamboo, bicycle spokes parts from sewing machines and anything else we needed and built a flying boat. That was seventeen years ago, after we had been flying our glider for some time. I was unable to get a motor that was suitable in this country, so bought two motors of French make.

"My first flight in this plane was something of an accident," Stewart laughed. "We had spent some time tuning up the motors, and I took the boat out to test them. I opened them up wide and roared down the Patapsco river, and all of a sudden I found myself in the air. I was as surprised as the people watching me, but I flew on a distance before venturing to turn, then made a sweeping turn that took in three counties and came back and landed.

"In those days you weren't taught to fly. There weren't many pilots, so it was a matter of building your own plane and flying it yourself in the best way you could. There was all the difference in the world between that old first plane of mine and the modern plane of today.

"Those old airplanes were made of flimsy bamboo and wire, and had their wings covered only on the upper side. You used your shoulders, hands and feet to control my first one, and there was an accelerator under one foot, like in an automobile. You sat right out in the open with nothing under you and very little around you.

"My old French motors developed 60 horsepower each, which was pretty good for a motor of that day. But we had a great deal of trouble with all motors then. The demands of an aircraft engine were not fully realized, and the makers did not have available the reliable materials that the industry has recently developed. Reliability was not a thing associated with the old motors. We were lucky to get 10 hours of intermittent service without some serious failure."

Today Captain Stewart is an engineer well known in aviation circles, and is engineering officer for the Air Corps, Maryland National Guard.

# How to Build a Compressed-Air Model

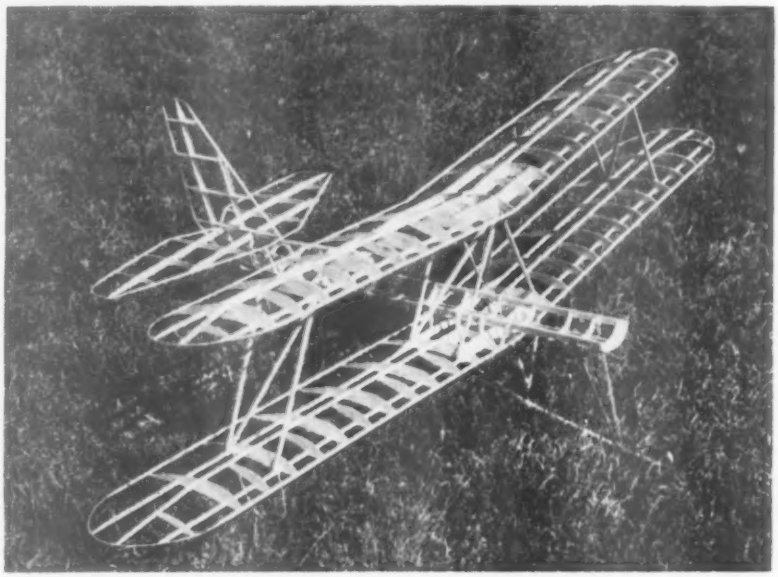
*by*

JOSEPH S. OTT,

*Model Editor*

*of*

POPULAR AVIATION



Wings, fuselage and other structural members of the compressed-air model completely assembled but not covered. The air tank is carried on the fuselage.

THE interest shown in compressed air motor planes is on the increase and as numerous requests have been received from model builders, a plane of this type is illustrated with photographs and drawings in detail.

All the angles of construction and size were considered carefully, so that the amount of space required for the transportation of the model were reduced to a minimum. The tail is the only part that need be separated and removed as a unit. In this way the wings and the fuselage will easily pass through the door of a car and then may be transported readily to a good flying field. The rudder and elevator are very large as these two units are coupled closely to the body. A simple skid is employed which is built strong and protects the propeller in rough landing.

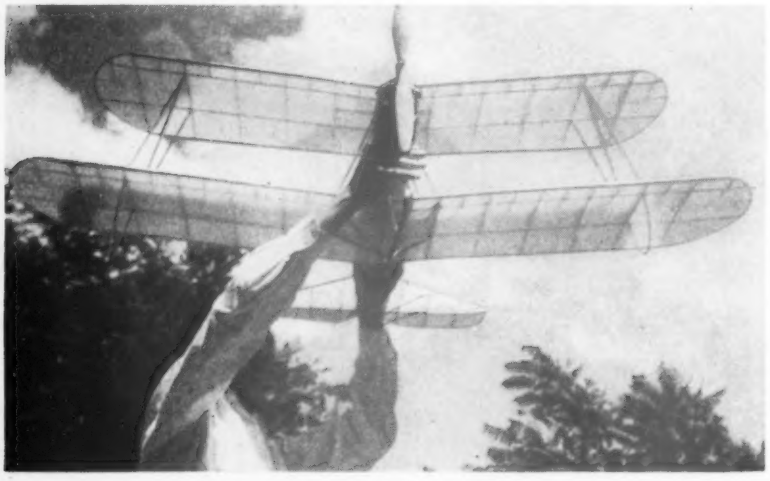
Because of the short wing span and also in order to keep the center of gravity low, a small additional wing was placed above the main wing. The main reason for this small wing was to give additional lifting surface without increasing the drag too much above the center of gravity, but at the same time the use of this small wing and its position helps to lower the center of gravity.

At first glance, the appearance of the model is awkward, but considered from a practical stand-point, it offers the best solution for a small wing span and a low center of gravity.

The fuselage is very simple, being built up from two longerons 5/32x½x 40" long. The rear part at the first full station or body former is round and gradually tapers to the rudder post. The front part is built semi-circular and will fit either a 24" or 30" air container. The test model was supplied with a 24" air container and was moved forward allowing a space of approximately 2½" between the end of the head and the first body former.

To streamline this part, a piece of stiff paper was held in place by two rubber bands. This accounts for not showing any space in the photgraph. The air container itself is held in place by three sets of individual rubber bands passing over and around the whole body. These bands should be very wide and must hold the tank very firmly so that it does not slide nor move from its original setting made at the time the model was balanced. The air container slides forward and backward, and in this way the correct center of gravity is located.

The total weight of the completed model, without covering, is 6¼ ounces and the complete model ready to fly, including air container, propeller and motor, weighs just a fraction over 16 ounces.



Completed compressed-air driven model ready for launching after the air tank has been pumped up to full pressure. An interesting and satisfactory model to build.

## *BUILDING THE MODEL IN DETAIL*

### *The Wings*

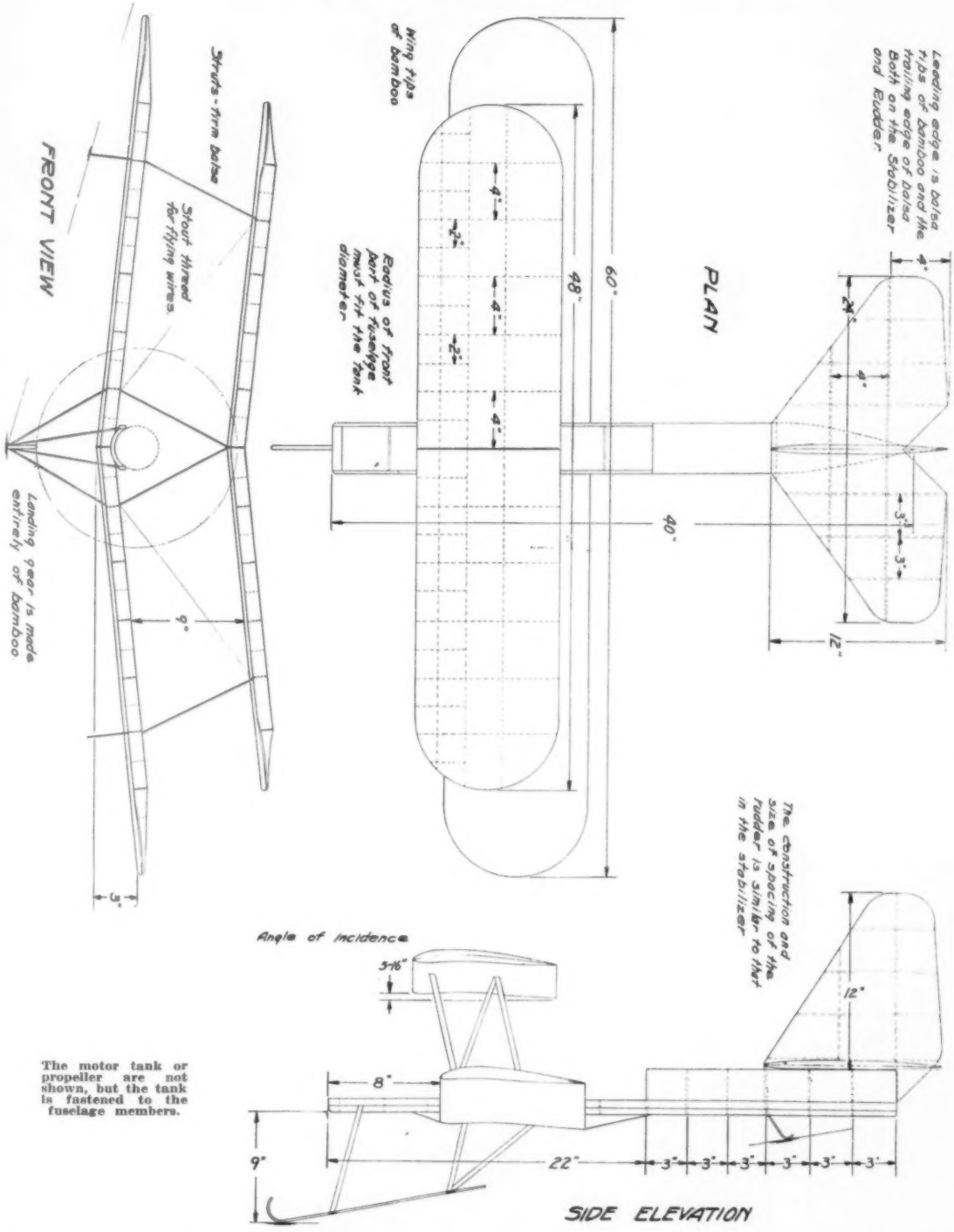
A full size rib pattern of the wing section should be made from a hard thin piece of wood or metal, so that the contour will not be lost when drawing the pencil along the edges when the different ribs are made. Twenty-four large full size ribs are required for both wings and twenty-eight nose ribs. A full size rib drawing can be had by mailing in the coupon attached at the end of this article.

The full size ribs are spaced four inches apart and the nose ribs are placed between each large rib. This

(*Continued on page* 190)

# Compressed-Air Driven Model

## *A Non-Scale Flyer*




The motor tank or propeller are not shown, but the tank is fastened to the fuselage members.

## Compressed Air Model

(*Continued from page* 188)

reduces the space from rib to rib at the leading edge where it is necessary to maintain the shape of the wing. The nose rib sets up against the spar which is placed on the top side of the main rib.

The shape of the ribs and the wing panels are the same on all four sets. Therefore, a full size drawing of the lower wing should be sufficient from which to build all the wings with the exception of reversing the wing tips on two of them. The wing panels are then arranged in pairs, mounted on a large board, set to the proper dihedral angle and then cemented to the center.

The top wing, being a trifle shorter, is given the same amount of dihedral angle so that the struts near the center of the body will be the same length as those near the wing tips. The completed wings should be allowed to dry and remain pinned to the board until the rest of the model parts have been completed. If these parts are allowed to remain in position after being cemented it will decrease their tendency toward warping out of shape.

Showing air motor and tank.

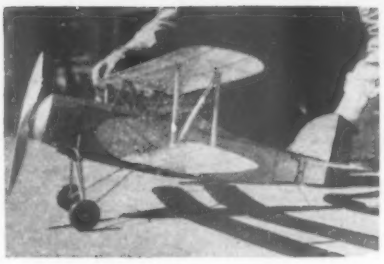
### *Fuselage Construction*

Building the body is a comparatively simple operation. The two longerons are placed face down. The underside and front section, having an inside radius of three inches, although reaching only from one longeron to the other are attached and cemented in place first.

Half of the semi-circular sections are made of three-ply veneer in the front part and the first complete circular former, but the remaining ones are cut from 1/16 inch balsa. Note, on the photograph, the nose block on the front end of the two longerons. This piece of balsa is curved on the front side so that it streamlines into the air container which rests securely against this part.

### *Rudder and Stabilizer*

The rudder and stabilizer are made entirely of balsa with the exception of the small curved section at the tip. The same piece of bent bamboo will fit all three corners. Cover the stabilizer completely, then cement the rudder on the center rib and add two braces—one on either side—approximately 1/32 x 3/16" which will help to strengthen and hold the high rudder in a rigid position. The center rib of the stabilizer is reinforced so that the total thickness is the same as the top fairing strip on the body.



Side view showing "N" struts.

The stabilizer is then fitted to the fuselage and a small one inch length of three-ply veneer is cemented to the top fairing strip which is held on both sides and against the center rib of the stabilizer.

These small strips, four in number, hold the stabilizer securely in place in front of each spar. In addition, two braces on either side of the stabilizer reach down and are bent so that the end is flat against the side of the longeron.

A hole is drilled through each one of these braces which in turn are reinforced by about six turns of thread above and below the hole.

Protruding from the longeron, in line with these holes on the stabilizer braces, are a set of four bolts of a very small diameter—approximately 1/16 inch O.D. or a 2-56 thread. The bolt faces outward and is secured by cementing a small block of balsa over the head on the inside. With this arrangement the entire rudder and stabilizer unit may be removed or placed in position in a very short time.

### *Landing Gear*

The landing gear is built of bamboo and carries the entire shock of the model when landing. The main wing

### *LIST OF MATERIALS*

*Fuselage or Body*

| | |
|---|---|
| Longerons—5/32 x 1/2 x 40" firm balsa | 2 pieces |
| Nose Block—3/4 x 1 x 3" balsa | 1 piece |
| Body Formers—1/32"—4 x 12" plywood | 1 piece |
| Body Formers—1/16" balsa sheet | 1 piece |
| Fairing Strips—1/8 x 1/4 x 24" balsa | 6 pieces |
| Bamboo Landing Gear—1/16 x 1/4 x 15" | 8 pieces |

*The Tail Unit*

| | |
|---|---|
| Rib Sections—1/16 x 2 x 24" balsa | 2 pieces |
| Spars—1/16 x 1/2 x 24" balsa | 3 pieces |
| Entering Edge—3/16 x 3/16 x 24" balsa | 2 pieces |
| Trailing Edge—1/16 x 1/4 x 24" balsa | 2 pieces |

*Wing Structure*

| | |
|---|---|
| Ribs—1/16 x 2 x 24" balsa | 4 pieces |
| Spars—1/8 x 1/4 x 30" balsa | 12 pieces |
| Leading Edge—3/16 x 3/16 x 30" balsa | 4 pieces |
| Trailing Edge—5/32 x 5/16 x 30" balsa | 4 pieces |
| Wing Tips—1/16 x 1/4 x 15" bamboo | 2 pieces |
| Struts—1/8 x 3/8 x 24" firm balsa | 5 pieces |

*Miscellaneous Parts*

| | |
|---|---|
| Tissue paper—21 x 31" very fine bamboo tissue | 5 sheets |
| Tissue paper—21 x 24" Hakone—red | 2 pieces |
| Cement—large tubes | 2 tubes |
| Dope—large jars | 2 jars |
| Propeller Block—1 1/8 x 1 5/8 x 15" firm balsa | 1 piece |
| Power Plant—1-3C motor and 24" air container. | |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| 1/8 x 3/16 | 20 for .09 |
| 1/8 x 1/4 | 20 for .12 |
| 3/16 x 3/16 | 20 for .13 |
| 3/16 x 8/16 | 20 for .16 |
| 1/4 x 1/4 | 20 for .17 |
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| 1/2 x 1 | 1 for .06 |
| 1x1 | 1 for .11 |
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| 2x2 | 1 for .30 |
| 2x3 | 1 for .40 |
| 2x6 | 1 for .60 |
| 3x3 | 1 for .50 |

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| 1/32 x 2 | 5 for .08 |
| 1/20 x 2 | 5 for .08 |
| 1/16 x 2 | 5 for .08 |
| 3/32 x 2 | 4 for .08 |
| 1/8 x 2 | 4 for .12 |
| 3/16 x 2 | 2 for .10 |
| 1/4 x 2 | 2 for .11 |

**PROP BLOCKS**

| | |
|---|---|
| 1/2 x 3/8 x 5 | 2 for .01 |
| 1/2 x 3/4 x 5 | dozen .10 |
| 1/2 x 3/4 x 6 | dozen .11 |
| 5/8 x 1 x 7 | dozen .15 |
| 5/8 x 1 x 8 | 3 for .05 |
| 3/4 x 1½ x 9 | 3 for .05 |
| 3/4 x 1½ x 10 | 2 for .05 |
| 3/4 x 1½ x 11 | 1 for .04 |
| 7/8 x 1½ x 12 | 1 for .05 |
| 7/8 x 1¾ x 16 | 1 for .09 |

**PLANKS**

| | |
|---|---|
| 2 x 3 x 36 | .42 |
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Sheet Aluminum (12" wide), .002, per ft., .12; .005, per ft., 11; .010, per ft., .13; Washers, large or small, 2 dos., .03; Eyelets, 3 dos., .10; Double Geared Winders, each, .25; Sandpaper, 1 dos. sheets, .10; Reed, 1/32" diam., 3/64" diam. or 1/16" diam., 6 ft., .03; 1/8" diam., 2 ft., .05; Bamboo, 1/16x1/4x12, dos., .07; 1/16x1/4x15, dos., .08; 1/16 sq., 2 dos., .05; Airplane Insignia—stars in circle or bulls-eye (red, white, blue)—1" diam., 8 for .05; 1½", 7 for .05; 2½", 6 for .05; Celluloid Wheels in all colors, 3/4" per pr., .04; 1", per pr., .06; 1¼", per pr., .08; 1½", per pr., .12; 2" per pr., .25; Aluminum Tubing, 1/16" O. D., per ft., .05; ⅛" O. D., per ft., .06; 3/16" O. D., per ft., .08; Dummy Motors—9 Cylinder, 1½" diam., each, .16; 2" diam., each, .23; 3" diam., each, .29; Drag Rings, 1½", .18; 2", .20; 2½", .25; 3", .27; 3½", .35; 4", .45; Open Cowlings, 1½", .18; 2", .20; 2½", .28; 3", .30; 3½", .40; 4", .50; Closed Cowlings, 1½", .18; 2", .30; 2½", .28; 3", .30; 3½", .40; 4", .50; Black Celluloid Pants, pair, .25; Small Pants, 1¾" long, for 1" and ¾" wheels, pair, 14; Black Celluloid Cowlings, each, .20; Colored Dope: Colors: Orange, Red, Green, Silver, Yellow, Blue, Black, White, Buff, Navy Grey, Mahogany, Olive Drab, 1 oz. bottle, .06; 2 oz. can, .09; pint can, .55; Colorless Cement, 1 oz. bottle, .06; 2 oz. can, .09; pint can, .65; Thrust Bearing, small and large sizes, each, .01½; per dos., .15; Clear Dope, 2 os., .07, pt., .37; Banana Oil, 2 os., .07, pt., .37; Acetone, 2 os., .06, pt., .35; Para Rubber—no rubber is over 5 weeks old—1/16 flat, 50 ft., .12; 225 ft., .50; ⅛ flat, 50 ft., .13; 225 ft., .55; 3/16 flat, 50 ft., .17; 225 ft., .75; Japanese Tissue—Red, Blue, Green, White, Orange, Brown, and Yellow—5 sheets, .10; Music Spring Wire, .014, .020, .028, .034, 18 ft., .05.

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is attached to the body before the landing gear is put in place. Approximately four small upright braces are used from the main wing to the longeron and must hold these two units together firmly so that no play or wobble is noticeable. See front view of the skeleton model. This shows very clearly the attachment and also that the landing gear at the rear brace is attached to the wing.

*End Struts*

When attaching the main wing to the fuselage or body, be sure that the leading edge is higher than the trailing edge by 5/16 of an inch. The stabilizer should be in a neutral horizontal position. It is best, before attaching the landing gear, as explained in the preceding paragraph, to check carefully over the angle of incidence. A large table upon which the wings and the complete body may be held in place is very desirable at this time.

A framework of light balsa strips, similar to a midget scaffold arrangement and which passes underneath the top wing including the 5/16", which is used to check the angle of incidence. The top wing should be held securely on this scaffold until all the end struts are placed and cemented firmly into the wing structure. After the end struts are in place, the wings will retain their form and the tendency to warp will be eliminated.

Because of the large wing sections, covering the model is not a very difficult operation. Therefore, the complete structure is assembled before this operation. It was necessary to cement the struts along the full depth of the spar and if this is done after the covering has been applied, it will be necessary to cut away so as to have sufficient room to allow this work to be completed. The finished results would be the same and therefore it was thought proper to completely assemble the skeleton and check over the angle of incidence first.

*Wing Skids*

To protect the wing tips, when the model leans over and scrapes along the ground, a wing tip skid employed as illustrated in the photographs and drawing will help to prevent it from crushing or breaking the tips. A piece of bamboo, bent to a semi-circular form and three inches deep in the center, is securely cemented to the rib which in turn holds the end struts. The size of this skid depends upon the total weight of the model. It should not be so strong that it will not "give" when it strikes the ground but rather it should be a trifle flexible.

*Covering*

Dope, or banana oil, is used for sticking the tissue on the framework. In the list of materials, the fine bamboo tissue is specified and used in conjunction with Hakone. Hakone is much lighter and is not quite as strong as the bamboo tissue, but no difficulty was encountered with the combination color scheme used.

After having sprayed the complete covered model with water, the amount of shrinkage was the same on both kinds of tissue. The rudder and elevators are entirely red and the top wing (see photograph) is covered using two colors and off-set by running a ⅛ inch black stripe where the two colors meet. No dope or banana oil was used to draw taut the finished covering, but the skeleton is amply strong to allow the use of either a light grade of dope or banana oil.

*Power Plant*

The power plant used in this model is an efficient type of three cylinder compressed air motor which may be obtained from various model dealers throughout the country. The propeller should have a pitch between 15 and 18 inches, depending upon the bore and stroke of the motor. The power plant complete, with a 24" air container, will weigh around eight ounces.

Before flying the finished model, the propeller should be removed from the motor so that the shaft or the mounting brackets will not be bent out of shape until the model has been balanced to give proper results when flying. The glide of the model should have a tendency to be a trifle nose heavy and the power unit may gradually be moved back until the proper position is found. The propeller should have a thin piece of pipe or other hard wood cemented to both sides so that the nuts and washers will not dig themselves into the hub.

It is the usual practice to attach the three cylinder air motor to the end of the cylindrical air tank, using the pipe connection as a motor bracket. A small valve in this pipe connection is provided for stopping and starting the motor.

The compressed air tank is cylindrical with hemi-spherical heads. It is built of very thin copper sheet wrapped with fine piano steel wire to strengthen it against the air pressure. Of course, the larger the tank, the greater will be the duration of the flight. It will withstand a pressure of about 125 pounds.

*Note! The Model Department will send a full size blue print of the 10-inch Rib and Nose Rib upon receipt of a 5c coin or stamps.*

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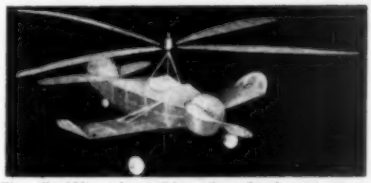

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## Howl Department

(*Continued from page 155*)

*We don't want to stunt—we want to build up time and just enjoy the thrill of flying. Then have the ship inspected, say twice a year, to see if the owner is keeping it in a good state of repair.*

*You other fellows begin your Howling and send in some other suggestions for relief of these existing, unfair laws. And I know that P. A. will cooperate and help to work out a satisfactory plan. After a good plan has been arrived at, I wish it would be printed and circulated in the form of a petition, and then presented to Congress.*

*Come on all you amateurs, and Howlers and let's Howl and keep on Howling until something is done.*

*Sincerely yours,*
*Aubrey Blackburne.*

Just what the legal status of the state laws is in respect to Federal laws, is a matter that will be taken up by P. A. in the near future. At first glance it would seem that a state law could not conflict with a Federal law, but in the back of the Department of Commerce Regulation booklet is a statement to the effect that states or municipalities are permitted to draw up their own regulations or make such

AND now comes another friend of amateur aviation, Carl W. Lechleiter, 1654 West 38th St., Los Angeles, Calif., who proposes remedies for the present conditions which should have your full attention. In this most excellent and informative letter, Mr. Lechleiter says:

*I wish to compliment you on the attitude which* POPULAR AVIATION *has taken toward the amateur aircraft builders of this country.*

*I will try to make a clear explanation to you of: first, why state license laws were adopted; second, the parties included concerning their adoption; third, why they have accomplished practically no real good for the industry, and finally, suggestions for the remedy of this injustice to the truly airminded men of the United States.*

*Back in 1926 the Federal government enacted certain laws governing aircraft operated for commercial purposes only. These regulations were of great value to aviation in that they grounded many unairworthy planes and also helped to give the public confidence in flying equipment.*

*There were still quite a number of obsolete airplanes being used for sport flying which were causing quite a number of fatalities each year. There were very few home-built aircraft up to this time because the country was flooded with very cheap planes.*

*Due to the afore-mentioned Federal regulations, the commercial operators had been forced to buy new equipment but still many crashes were occurring in in the ranks of unlicensed aircraft. It was then up to the state legislatures to pass some kind of law which would ground these unlicensed ships. There was but one quick way to do this, which was to apply the Federal commercial aircraft requirements to all aircraft flying within their state boundaries.*

*We must remember that the amateur builder division of this industry has developed noticeably in any particular state only after the laws of that state have grounded the unlicensed planes. The state legislatures had no knowledge whatever of the consequences of the laws made by them. The manufacturers made a big mistake in thinking that the fellows would be forced to buy their ships. As you see, the laws have been wrong from the time they were passed.*

*As a remedy for all this, I have the following suggestions to offer:*

*1. We must have a national organization with its branches in each state.*

*2. We will have to have a large membership.*

*3. Lobbyists may be needed in each state to explain the situation in the correct manner for modification of the laws.*

*4. We should cooperate with the state branch of the Department of Commerce in each state and try to arrange for their engineering department to OK each set of plans, which each member is subjected to submit to them for approval, before the construction of his ship has begun.*

*5. After the customary inspections during construction, the final inspection, and the flight test, the Department of Commerce issues a special license which is good for a specified length of time. At the expiration of this license, another is issued if the ship passes this inspection.*

*6. The engine tests shall be agreed upon by the members and the Department of Commerce. It should be an endurance test of a certain number of hours.*

*7. Any sportplane manufacturer is welcome to membership in this organization. He must have his ship's plans OK'd as above stated.*

*8. The member building ships from manufacturers' plans are required only to have the inspections during construction.*

*9. There are to be absolutely no stress analysis computations required for license eligibility.*

*10. This organization will be doing all in its power for the development of private flying and not just form method of breaking laws.*

*There is one important thing to remember. That is, that we should be very careful in making accusations against any persons connected with aviation, as we need the goodwill of everyone. If there is any crookedness and graft going on through the enforcement of these license laws, we will know about it when they refuse our proposition.*

*I trust that you and* POPULAR AVIATION *will show this movement due consideration.*

*Sincerely yours,*
*Carl W. Lechleiter.*


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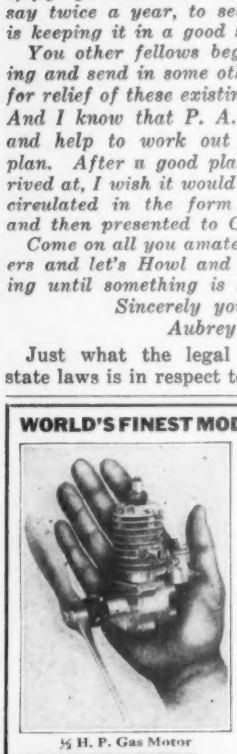

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## Engines

(*Continued from page* 174)

for the reason that it represents the sea-level atmospheric pressure of 14.7 pounds per square inch. Any point located above (X-X) will be above atmospheric pressure, while points below the line represent a partial vacuum or "suction pressure".

Fig. 2 is a perfect or "ideal" pressure-volume diagram. It represents the cylinder pressures existing within the cylinder at any instant during each of the four strokes of the cycle. For ease in explanation, each of the curves is drawn by a different kind of line so that the various events can be easily distinguished. Also, arrows are shown on each of these lines to show the direction in which the piston is moving at that particular time, the cylinder head being assumed at the left of the illustrative diagram.

Now let us start with the suction stroke at (1) where the piston is shown moving to the right. The piston now creates a part vacuum in the cylinder, the extent of which is indicated by the dash-dot suction curve (1-2) dropping below the atmospheric pressure line (X-X). The suction stroke ends at (2) and, starting at the same point, the compression stroke begins toward the left along the coarse dotted curve (2-3).

JUST at this point (3), the igniting spark takes place and the pressure builds up rapidly with the combustion along the vertical line (3-4) where the maximum combustion pressure (E) is reached. The piston now starts out toward the right on the working stroke along the expansion line (4-5), dropping pressure all along until the end of the stroke at (5) where the exhaust valve opens. It will be seen that a considerable amount of pressure (5-2) still exists at the time that the exhaust valve opens to perform its operation.

Next comes the left hand "scavening" stroke along (5-6), still somewhat higher than atmospheric pressure due to the friction in the exhaust passages through which the burned gases are being forced out to the outer air. This completes the cycle and shows how the pressures vary during this time.

This diagram can be traced out for any engine by an instrument known as an "indicator", so that the events taking place in the cylinder can easily be studied. Due to varying loads, varying mixtures, changes in the ignition point or valve timing, the curve takes on special forms that may differ considerably from the ideal diagram shown here. The indicator is a valuable means of studying an engine and correcting errors that may be caused by improper adjustments, for it traces a complete diagram out on a card that shows actual conditions.

The diagram also is a means of computing the horsepower actually developed within the cylinder of the engine.

Now, it is evident that the work done during the power stroke depends upon the average pressure acting on the piston throughout the stroke. This average pressure is called the "mean effective pressure" and its value is indicated in Fig. 2 by the horizontal line marked "mean effective pressure" or the abbreviation "M. E. P." The M. E. P. is considerably lower than the maximum pressure and is considered as the steady pressure acting on the piston throughout the stroke of the piston. Its relative value depends upon a number of factors, the mixture, the compression pressure, the cooling system, timing and similar items.

DEPENDING upon the various conditions, but mostly on the compression, the maximum pressure (E) will range from 150 to 350 pounds per square inch. This peak pressure increases with the compression, roughly speaking, the maximum pressure (E) is about three times the compression pressure. This relation is not exact, however, and only gives an approximate idea of its magnitude. The mean effective pressure, also a variable, will run from 50 to 80 pounds per square inch at full load.

Just as an example of how the ideal diagram can be distorted by various causes, I am showing Fig. 3 in which distortion takes place due to "retarded" or delayed ignition. Instead of the spark occurring exactly at the end of the compression stroke, as before, the spark is shown after the piston has started to move down on the working stroke. Retarding the spark after the end of the compression stroke delays all of the events so that it has a material effect upon the performance of the engine.

In Fig. 3, the piston moves up on the compression stroke from (5) to (3), and as the spark does not take place at (3), the pressure starts to fall after the piston moves to the right. At (3A), the spark finally occurs, but as the compression pressure is now reduced, the burning is slow and the pressure does not build up along a vertical line as before but rather droops toward the right. The compression pressure at the point of ignition is about 25 per cent lower than the maximum compression and the maximum combustion pressure (4) is very much lower than with ignition taking place on center.

Since the mixture is ignited later, the combustion continues throughout the expansion curve and is not completed at the end of the working stroke. The result is a much higher terminal pressure (e) before the exhaust opens and a greater loss of power and heat because of this higher exhaust pressure. Further, there is also a loss of unburned gasoline that greatly reduces the possible efficiency of the engine.

TO show the relative effects of retarded and advanced ignition, two diagrams are superimposed upon one another in Fig. 4. Here, the diagram in dotted lines is the same retarded spark diagram just shown while the diagram shown in full lines is the diagram produced by "advancing" the spark so that it occurs before the piston reaches the end of the compression stroke.

It will be noted that the maximum combustion pressure with the advanced spark is very much higher than the maximum pressure with the retarded spark. As combustion is generally completed (with a good mixture) before the piston has moved very far on the working stroke, the expansion of the gases is more complete.

END


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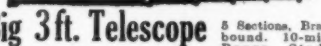

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## Capt. Rene Fonck

(*Continued from page* 148)

usually successful in getting through the lines and obtaining valuable information as to the location of our trenches and our gun positions. It was entirely up to the French planes in this sector to cope with the situation for there were but few American planes in France at the time.

German planes were very active in this sector and they took advantage of every opportunity offered them for observing and making maps and photographs for future use. Every plane that the French shot down brought two enemy planes in its place. They seemed to have an unlimited supply from which to draw.

The horse-lines were bombed almost every night with high-explosive bombs. A great number of the best horses were killed and some were so badly wounded that they were shot to end their pain and suffering. Quite a few of the men who had been left to care for the animals were also killed and wounded.

Orders were given at intervals of from three days to a week, to change the location of the horselines, but to no good effect. The German observers found them just the same and continued peppering both horses and men until some drastic measure could be formulated. Throughout this time, squadron after squadron of enemy machines with capable pilots and observers hedged carefully above the clouds, found their way into our lines.

The French didn't seem to make any effort to drive them back—perhaps they had their reasons. However, the number and superiority of the enemy planes must have discouraged the French in any attempt to keep the enemy planes well within their own lines.

IT was not long before the American Military authorities filed a vehement protest against the French Aviation authorities for not co-operating with them. In response to this protest, the French ordered Captain Rene Fonck and his squadron of combat planes to the rescue; or rather to endeavor to hold the German pilots from getting across our lines and causing so much unnecessary death and destruction. Fonck arrived at the field, well behind our front lines, on May 25th, 1918.

About 2 P. M. of the following day, the Germans sensed that additional French planes were on duty in this sector, for instead of flying low as before, they kept at a high altitude. Perhaps, through their intelligence department, they had information that the great Ace of Aces, Captain Rene Fonck, was there with his squadron.

Fonck took to the air and flew at an altitude of about 3,000 feet, but he had been warned that this was dangerous practice. After lighting a cigarette and enjoying a few puffs, he jumped into his plane. Dark clouds were floating across the sky — good places for enemy planes to hide in and swoop down upon him. He paid no attention to the clouds but kept right on going until he got to a point directly above the German front line trenches.

He circled until he had reached one of the clouds—then ducked into it out of sight. Soon there was heard the droning of several motors and high up above the clouds could be seen a squadron of German planes. After making several circles they began to drop gradually until they were about 200 feet above Fonck's plane, then they separated and endeavored to close in on him from above.

Aware of what was transpiring dangerously near him, Fonck spiralled, straightened out, banked and pointed the nose of his fast plane upward at a sharp angle. This completely disconcerted the German pilots. At the bat of an eyelash, Fonck's machine gun spoke and one of the German planes caught fire, split in two and crashed to the ground below.

THE battle kept on. Machine guns blazed away at Fonck's plane. Several times he was surrounded but his skillful manuvering had the Germans guessing. Making a quick dive as if falling to earth, Fonck then straightened out, zoomed upward unexpectedly and opened his machine gun. The bullets reached their victim and another enemy plane crashed to earth in flames. The remainder of the German planes were frantic—they spiralled, banked, zoomed upward, dipped and dived in an effort to outwit the canny Frenchman. They could not seem to get him. The machine gun on one of the German planes was jammed.

Captain Fonck had already brought down two planes. He was still going strong although one of the wings on his speedy machine was riddled with holes. How long could he stand up under this terrific strain? Was he going to stay in the fight until he was killed or was he going to return to the field and call it a day?

Like a flock of angry crows, incensed at the loss of one of their party, the remaining German pilots made a formation and signalled to each other for the next move. While they were thus engaged, Fonck nosed his plane skyward and circled until he reached one of the clouds. Apprehensive, the Germans split up. They were in a quandary. Fonck was lost.

Then, like a giant eagle he dropped out of the cloud, looped twice and forced one of the German planes downward. Repeating this clever maneuver, he forced still another back to its own lines in a short time.

Dexterously, quickly, Fonck then banked, zoomed upward, made a wide loop and coming directly in under the remaining German plane, pumped a drumfull of lead into the gasoline tank.

There was a terrific explosion, a burst of flame and the plane crashing to the earth barely missed Fonck's, who dipped and missed being entangled himself. The battle lasted about a half hour during which time Fonck had brought down three planes and forced two out of the running. Arriving back at the field he was interviewed by the rest of his men. One of them asked him how he did it and he replied:

"Just luck. I thought that I was going to get it any minute. My right wing was about ready to collapse, but with all those Germans after me I might just as well stay in the fight until something exciting happened. As it was—it was a quiet day."

END


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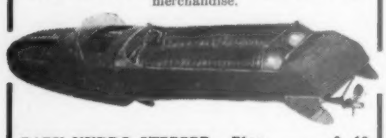

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## Picking Up Mail

(*Continued from page* 167)

if too great a load is encountered. It must be remembered that an airplane, in flight, is cushioned in air and is saved from the sudden jars that result when it lands on hard ground. The cushioning eases any jar or sudden jerk which tends to injure the fuselage.

In addition to official tests made at Washington, similar trials have been made in many different localities, under all types of wind and weather. Pilots have used various types of aircraft, planes of open as well as closed cockpits, and even dirigibles. So, it would seem from the evidence produced from these exhaustive trials, that at last the problem of providing America's thousands of smaller towns and cities with the advantages of commercial aviation has been solved.

END

## Purcell vs. Mr. "X"

(*Continued from page* 164)

And now for your next paragraph—the most asinine of your conglomeration of asininity. You state that no airline executive or radio operator ever caused a pilot to proceed through weather which in the pilot's opinion was dangerous.

Do you remember the crack-up on the Ridge Route when eight passengers and the pilot were washed out trying to go through a storm? Do you remember the tri-motor job that was washed out along with its passengers and pilot in Southern California, while coming in under a ceiling so low that the ship hit a power line?

Do you remember Starbuck and Parmalee and the soupy weather they were washed out in? Do you remember Jack Sharpnack who was sent out in soupy weather after another of the company pilots had made the attempt and came back? Do you remember Crandall and Johnston who were also washed out in soupy weather? And with all this you still make the above statement?

In your next paragraph, you excuse the Department for making mistakes for which there is no reason. Let it suffice that the ship I had in mind when I wrote the article was the low-wing Barling, which was licensed and sold for several months before the Department realized it was unsafe. Buyers of this ship in most cases had been compelled to assume the loss of the purchase price. The aviation business is a poor place for guess work and mistakes and this mistake on the part of the Department cost innocent purchasers a lot of money—with little if any chance of getting it back.

In your next paragraph you stated that you stunted Jennys without knowing how much stress you could put on them without washing out the ship. Any man who ever flew a Jenny during the war and did not know what the ship could stand was the world's biggest half-wit. Did you never study rigging ships, Mr. "X"? I'm sure the school at which you trained had a course in this, and if you could not grasp its fundamentals that was simply your hard luck.

It would seem that in this paragraph you have strutted your absolute and complete ignorance in relation to a Jenny—God bless 'em. You also state here that many of our best pilots were killed from this stunting of JNC'S. You have evidently never barnstormed Jennys, Mr. "X," and I will not embarrass you further with the merits of this ship.

You even mention the fact that I am a destructive critic. This is a broad statement, with the usual foundation of your other statements—marshmallow.

Mr. "X," you can dunk your doughnuts in this little statement. I am now and always shall be a friend of every pilot in the country and that bars nobody—even yourself.

IF BY "destructive", you mean to destroy the hold the airlines have over the Department of Commerce, then I am willing to accept the adjective. Any time I think a pilot is getting the worst of the deal, I shall put in my two-bits worth and tell the world what I think about it. You can no doubt realize that in my position I can do this with no fear of having a ticket taken away.

In your next paragraph I find some truth. I have and always will feel that the Department can do a lot of good for the flying game at large. I am of the opinion that the Department is trying to do a lot but is working from the angle of the airlines—not the pilots' and passengers'. If you read back through some of my other articles, you will find that the Department has received due merit where merit was due, but this does not alter the fact that the Department still has a lot to do if the flying game is to prosper.

This can be accomplished only by giving the pilot more authority and less of the grief. I will go further and state that the Department as represented on the Pacific Coast is really trying to function as it should, but the lack of authority on the parts of the Inspectors when dealing with airlines happens to be its greatest draw-back. If you noted the end of my article in which I mentioned the United States Steamboat Inspectors, you would understand that I would like to see more authority given to the Inspectors of the Department. In a previous article I made my stand very plain.

You speak of my knowledge of air transportation being nil. When you have owned and operated a small outfit such as mine was, even the dumbest Dodo in the world must learn a little something of it.

END

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Directory. Rates: $2.00 per insertion.

If you have anything to buy;
If you have anything to sell;
Use This Directory

## AIRPLANES

**CORBEN SPORT PLANES**
**"CORBEN BABY ACE"**
Snappy single place sport plane
**"CORBEN JUNIOR ACE"**
Two-place convertible sport plane
Both are now offered flyaway or in semi-built kits for the home builder.
Send dime for illustrated folder
**CORBEN SPORT PLANE CO.**
2002 E. Johnson Madison, Wis.

**SALE**
1—1 place Aeronca.....$ 395.00
1—2 place Aeronca.....$1175.00
1—Great Lakes Sport Trainer..$1195.00
Aeroncas bought, sold or exchanged
**F & S AIRCRAFT CORP.**
**200 E. Roosevelt Blvd., Phila., Pa.**

**For Sale or Trade**
American Eagle, Kinner powered, three place cabin job. A-1 condition, just overhauled. Cheap for good cash offer or will consider good biplane or Curtiss Jr. in on trade.
CARL E. JOHNSON W. R. TWITCHELL
Box 101 or Box 252
Woodhull, Ill. Cozad, Nebr.

## AIRPLANE PLANS

**FORD! Model "A" Sportplane**
**2-place Speedster**
A proven, practical and tested design with beauty. 300 hours without crash nor engine failure to date.
Span 30' Speed 80 M.P.H.
Length 22'4" Cruise 75 M.P.H.
Height 8'3½" Land 31 M.P.H.
Complete drawings ONLY $1.00; formerly $3.00 and a true $5.00 to $7.50 value. 1932 Catalogue 15c.
CAPITAL (PA-3) AIRCRAFT, MADISON, WIS.

ATTENTION LIGHTPLANE BUILDERS
Pientenpol Aircamper Parts (New Production):
Fuselage.....$ 45.00
Spars, set of four (finished).....16.00
Ribs, each......50
Spruce, Clear Selected, ⅜ x ⅜, ¼ x ¼, ¼ x ½, 500 ft.....4.50
SEND FOR OUR COMPLETE LIST
Heath Plane (less wing and motor).....100.00
8B Henderson Motor.....140.00
TERMS ONE-THIRD WITH ORDER, BALANCE C.O.D.
ECONOMOU AIRPLANE CO.
E. GEORGIA, VERMONT

## AIRPLANE SUPPLIES

**PROPELLERS**
Order from this ad, increase your ships performance.
4-ft. diameter for motorcycle motors.....$ 4.50
4-ft. 6-in. for Heath-Henderson metal tipped.....$ 8.98
5-ft. 6-in. for Ford T and Chevrolet metal tips....$10.98
6-ft. for Ford A, Lawrance & Ansani metal tips...$12.95
8-ft. for the 0 x 5, laminated Oak, copper tips....$19.95
Photo, Specifications. Bristol Cherub Type Motor selling at $150.00 and other bargains including leather bound flying Manual 25c stamps.
HIBBS, Ft. Worth, Texas.

**AEROPLANE MOTORS**
Wright Whirlwind J5 complete used $300.00. Curtiss Challenger complete used $250.00. Curtiss OX5 used $40.00, New $75.00. Cleone 25hp $75.00. Lawrence 28hp $60.00. Le Blond 55hp $150.00. Hispano 150 used $35.00. Parts for Wright J5-J6 in the 5-7 and 9 cyl. motors. Gipsy, Cirrus OX5 and Hispano motors also.
MARVIN A. NORTHROP AEROPLANE CO.
730 Washington Ave. N., Minneapolis, Minn.

**WELDED STEEL FUSELAGES** complete with Split Chasse, Tail Groupe with tubular control, Skid and Motor Mount, Single place Heath type $78.00. Single Place Pietenpol Type $98.00. Two Place Pietenpol Type $120.00. New Super Heath Ship with New Spare Motor, built by Travil Air workman only $398.00, the best constructed Sport Plane ever built. Photo all information including Leather bound Flying Manual 25c stamps.
**HIBBS, Fort Worth, Texas**

**Propellers Maps Parachutes Telephone Sets**
New Hamilton wood J5 $50.00 Gipsy wood $30.00 New OX5 spinner Gardner, Supreme $40.00 Curtis Reid metal $50.00 without spinner $35.00 Warner Hartzell $35.00 Steel prop $150.00 Standard Steel right J5-J6—5-7 or 9 cyl. $175 each. Irving used silk pongee parachute repacked on sale by licensed packer $80.00 seat type. Rand McNally aerial maps any state (present supply) latest issue 50 cents regular postpaid $.30. Set Dh earphones new $15.00 reg. $5.00.
Marvin A. Northrop Aeroplane Co.
730 Washington Ave. North, Minneapolis, Minn.

**PROPELLERS**
4-ft. diameter, for engines up to 7 HP.....$ 8.75
4 ft. 6 in. for Henderson, Ace 4, etc.....$12.50
5 ft. for Harleys, Twin Indians, etc.....$13.25
6 ft. for Ford "A," "T," Chev., Star 4, etc...$16.50
7/32x7/32, ¼x¼, ½x½ spruce, 500 ft.....$ 5.00
Dope $1.50 gal. Thinner $1.50 gal. Pinked tape 3c yd. Grade "A" fabric, 50c yd.
OSTERGAARD AIRCRAFT
4305 N. Narragansett Chicago

Curtiss Fledgling used $850.00. Curtis Jenny complete set parts and motor you assemble delivery by truck $90.00. Waco 10 used $390.00. Travel Air 2000 at $415.00. DH Moth damaged less engine $100.00. New complete Pietenpol Air Camper test flown at $295.00. Robin stripped fuselage needs repairs $40.00. Travel Air 2000 perfect $35.00. Mohawk Pinto as is $25.00. Several more.
MARVIN A. NORTHROP AEROPLANE CO.
730 Washington Ave. N., Minneapolis, Minn.

Clear Acetate Dope in barrels, 50c per gallon. Clear Acetate Dope in 5 gallon cans, 88c per gallon. Clear Nitrate Dope in 10 gal. cans $1.08 per gallon. Yellow Pigmented Nitrate Dope, any quantity, 85c per gallon. Good strong commercial airplane fabric, 23c per yard. Plywood, 10c per square foot and up. Send dime for complete catalogue. **KARL ORT, 609 W. Poplar St., York, Pa.**

**Wheels Goggles Helmets Flying Suits**
Kelsey Hayes new production 24x4 $4.00 26x4 $4.00 war wheel new 20 inch dia. 3 inch tire light planes $2.00 each. 750x125 $4.00 each. Luxor goggles No. 5 regular price $9.75 now $4.75, No. 6 reg. $10.75 now $5.75, No. 7 reg. $13.75 now $7.75, Willson Pilot Goggle reg. $20.00 now $18.00. First Aid Kits regular $1.00 now $0.75. Spaulding Leather Chamois Helmets $5.00 now $3.00. Lee Zipper Suits white and brown $7.00 reg. now $3.75. Zenith Altimeters $3.00.
MARVIN A. NORTHROP AEROPLANE CO.
Minneapolis, Minnesota

New low prices on small engines, propellers, and hubs for light planes, windwagons, boats and scooters. Small bike engine $15, small Indian 3 cyl. engine $30, single cyl. Hedstrom with prop, $20. Twin cyl. engines, $35 to $50. Ford "T" and "A" motors, complete, ready to fly, $40 to $95. Efficient propellers at bargain prices. Mono-cycles, $20. Wheels with tires $3.50 pair (for small auto or plane). Flying Flivver blueprints, $5. Circulars 10c.
STORMS AVIATION CO.
Spartanburg, S. C.

Completely converted and rebuilt Model A Ford with prop., radiator, German Bosch magneto prop hub and motor mount. Priced right.
Lester E. Swain, Marengo, Ill., Phone 598

**TUBBS! SPEEDWING-SUPER-SPORTSTER MIDGET RACING BIPLANE**
Proven practical and tested basic designs of several NATIONAL AIR RACE WINNERS. Power: 2-cylinder 40 H.P. CROSS COUNTRY TWIN and others.
Span 13 ft. 8 in. Speed 145-185 M.P.H.
Length 14 ft. 11½ in. Cruise 130-150 M.P.H.
Height 5 ft. 1 in. Land 35-55 M.P.H.
Weight 325 lbs. Power 40 to 60 H. P.
Folder and sample drawing $1.00; REFUNDED on order of complete set of factory drawings. No free literature.
HOWARD A. TUBBS, Whitewater, Wisconsin

## ELECTRICAL

**ELECTRICAL Engineering Problems**
OF EXPERIMENTERS AND INVENTORS CONFIDENTIALLY SOLVED
**ELECTRICAL S. & E. BUREAU**
4735—159th St. Flushing, New York

**MOTORS—GENERATORS**
½ horse alternating motors $12.75; ¼ horse $4.50. Also special bargains in alternating and direct current generators. Write us for quotations on the machine you need. If in stock we can save you 50 %.
ELECTRICAL SURPLUS CO.
Dept. 44, 1885 Milwaukee Ave., Chicago

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**"Learn to Fly—$95.00"**
**F & S Aircraft Corporation**
**200 E. Roosevelt Blvd.**
**Philadelphia, Pa.**

**LEARN TO FLY FOR $75.00**
(Pay as you learn). 20-hour Private Pilot's Course $175.00. (Own your own Plane). A new two-place Rearwin Jr. and a complete flying course $1795.00.
THE REARWIN FLYING SCHOOL CORP.
Fairfax Airport, Kansas City, Kans.

**Roosevelt Aviation School, Inc.**
Government Approved for
Private, L. C. and Transport, Ground and Flying Courses.
119 West 57th St., New York City — Roosevelt Field Mineola, N. Y.

**$1 STARKS $1**
*1—2—3 Order of Instrument Flying—Described in "Blind or Instrument Flying?"*
Price $1 Postpaid
HOWARD C. STARK
P. O. Box 1 -:- Newark, N. J.

**THE MOST COMPLETE AVIATION EDUCATION AVAILABLE**
The oldest school of its kind in the United States offers courses in Aeronautical Engineering, Airport Engineering, Air Transportation, Ground School, Mechanics and Flying.
Our New Catalog "The Key to Opportunity in Aviation" sent free on request.
U. S. AIRCRAFT ENGINEERING SCHOOL, Inc.
1732 Grand Ave., Dept. G, Kansas City, Mo.

## MODEL AIRPLANES
(Kits and Plans)

**REAL VALUE**
**Baby Rog Kit 14" Wing Span**
**POSTPAID 25c CASH**
**Bennett, Box 53, Clarks Summit, Pa.**
Post card brings free price list of real values on quality model supplies.

Advertise in this Directory. Rates: $2.00 per insertion.

# BUYER'S DIRECTORY

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## MODEL AIRPLANES
(Kits and Plans)

### COMPLETE KIT
GEE BEE, LAIRD, STINSON, S. E. 5, BOEING P. 12. B.

Any one kit 75c P. P. 2 for $1.25.

**BROWNING-KING & CO.**
Model Airplane Dept.
15th and Douglas, Omaha, Nebr.

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Build Real Models of **FAMOUS PLANES!**

Over Plans—300—Kits to choose from

New 1932 Catalogue, highly illustrated, CASH 10c. This same Catalogue with "red-line" inserts 15c.
CAPITAL (PA-3) AIRCRAFT, Madison, Wis.

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**BOEING, CURTIS HAWK, SE5 & BULL PUPS**

Kits contain everything necessary to complete plane. Colored Berryloid wing dopes, cement, banana oil, rubber tired wheels, balsa wood and complete full sized plans, Etc. all postpaid. Boeing & C Hawk, $2.50. S E 5, $2.00. Bull pup, $1.00. Send 5c for catalog.

**CARDINAL AERO SUPPLY CO.**
9018 Linwood Ave. Detroit, Mich.

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### FLIES ONE MILE
Endurance cabin (fuselage) model makes flights of one mile. **Guaranteed** for ½ mile or **Money Back.** Wing spread 27", fuselage 21". Complete kit $1.25 P. P. Made by designer of famous Flying Glory Championship Model. Send 5c for catalogue listing other flying models.

CRESCENT MODEL AIRCRAFT & SUPPLY,
1805 Benson Ave., Brooklyn, N. Y.

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### FIVE PLANES
**$1.00 Postpaid**

Complete kit with instructions for five different flying models.
Single kit 25c. No stamps.

PELTON FERRY,
South Glastonbury, Conn.

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**FREE!** SUPERIOR MODEL AIRPLANES While they last

I am giving the following away FREE just to get your name and address for a "big announcement" coming soon. Set of 36½" DORNIER DO-X plans and instructions of greatest accuracy. You MUST send 20c to help cover expenses involved on this former $0.90 retail seller. Kit of materials for R.O.G. model featured in aviation magazine recently. You MUST send 10c to help cover expenses involved on this former $0.50 retail seller.

**B. C. LADWIG** 2306 Sommers Avenue Madison, Wisconsin

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Build These New Contest-Winning 10-inch

**SCALE MODELS** 99c Ea. Postpaid

Lindbergh's Lockheed Sirius (Models with or without pontoons)
Post & Gatty's Lockheed Vega.
Also 12 in. Flying Model, Curtiss Navy F9C2.
Semi-finished kits of famous planes, designed by Robert B. Ripin, M.I.T. Engineer. Most complete kits offered today. Startling values. Remit by check, or money order.

RIPIN MODEL AIRPLANE CO.
915 Franklin Ave., Brooklyn, N. Y., (Dept. P9)

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FLYING SCALE MODELS 75c

Boeing P12, Travelair, Fokker D-VIII, Lockh'd Vega, S.E.5, Neiuport Scout, Stinson, Sopwith Camel These construction sets contain complete material, stamped ribs, all balsa strips cut to size, wire parts all formed, cement, dope, rubber, tissue, celluloid wheels, full size plans and instructions, etc. Packed in single and attractive boxes. These are 15" flying scale models. Guaranteed to fly.

Send 3c Stamp for complete catalog. Include 15c for packing. Dealers and clubs write for large discounts.

MERCURY MODEL AIRPLANE CO.
1592B Lincoln Place, Brooklyn, New York

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### Build a Model Boat
Plans for 15" Model Boat.....25c
Above plans show cuts of various types of power plants.
5 Minute Spring Motor, Postpaid.....$1.00
Electric Motor, with permanent Magnet, Postpaid.....$3.00
We specialize in Model Boat Power Plants and do not put out a catalog. Money refunded if not satisfied.

SEATTLE MODEL BOAT CO.
1220 Boren Ave. Seattle, Wash.

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Boys! Build 2 planes for the price of one. Our supply kit contains enough balsa sheets, sticks, cement, plans, etc., to build 2–15" war plane models, sent post paid only $1.00. Perfect cut smooth blasa 36" long, 1/16" sq. 7 for $0.05. ¼" sq. 5 for $0.05. ½"x2" $0.05 each. ¼"x2" $0.06. Jap. tissue $0.04 sheet. Send stamp for price list and samples.

**SWALLOW MODEL AIRCRAFT**
3840 N. Newland Ave., Chicago, Ill.

## MODEL AIRPLANES
(Ready to Fly)

**MODELS READY TO FLY**

Your money back if they do not perform to your satisfaction. The Commercial 75c—The Wing 25c—Both 80c. Paper covered 12". Balsa frame 5" carved prop. Add 10c for shipping.

ARC AIRCRAFT
4015 Ellis Ave., Chicago, Ill.

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### FINISHED SCALE MODELS
Any type ship, wartime, historical and modern. Wingspreads 4½" to 6". Fine wood construction and standard paint jobs on all models except when otherwise requested. Glossy finish. You name the model. 5 day delivery service. Price $1.00 postpaid. 35c Canadian and foreign charge. All inquiries promptly answered on special model aviation projects.

MUELLER BROS.
28 Peach Street, Buffalo, N. Y.

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**MODELS BUILT TO ORDER**

Models Airplanes built from any kit now on the market. Others if plans can be obtained. Write for prices on any model. (Please enclose stamp.)

**Cleveland designed models a specialty**

SF-12 Nieuport Scout..$10 SF-21 Curtiss Hawk
SF-19 Supermarine.....14 P-6-E.....$12
Terms: Cash with order, or 50% cash, remainder C.O.D.
Prices F.O.B.—guaranteed Safe Delivery

FRANK T. ROBERTS
P. O. Box 294 Jamesburg, N. J.

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READY TO FLY—ALL BALSA MODELS

14 in. Soaring Glider. Price 25c, Post Paid.
18 in. R. O. G. Tractor—Flights over 1,000 ft. Price 75c.
18 in. R. O. G. Cabin Commercial—Flights over 500 ft., Price 75c.
22 in. R. O. G. Cabin Commercial—Flights over 1,000 ft., Price $1.25.
All Planes attractively colored and guaranteed to fly. 15c packing and postage charge on all motored models.

SEAGULL MODEL AERO CO.
155 Beach—113th St. Rockaway Park, L. I. N. Y.

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### True Scale Ornamental Models
Beautiful 20" fine, detailed, ornamental models of the CURTISS FALCON AC-3 and HAWK P-6-E, for the desk, radio or mantel. Completely finished models (construction kits) and blueprints are now available at special introductory prices. Write immediately for descriptive folder.

VICTOR STANZEL Schulenburg, Texas

## MODEL AIRPLANE SUPPLIES

### MODEL AIRPLANE SUPPLIES
Send your name and address for a sample of Balsa Wood and our prices on model airplane supplies.

**Aero Shop, 3050 Hurlbut Ave., Detroit, Mich.**

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**WHOLESALE PRICES!**

| Balsa Wood 36-inch lengths: | | Grade A Polished Sheets 36-inch Strips: | |
|---|---|---|---|
| 1/16 x 2-12 for | $0.40 | 1/16 x 1/16—50 for | $0.20 |
| 1/16 x 2-12 for | 0.45 | 1/16 x 1/8—50 for | 0.25 |
| 1/16 x 2-12 for | 0.55 | **Prop Blocks, Per Doz.** | |
| 1/16 x 3-6 for | 0.35 | 5" 9c; 6" 10c; 8" 20c; | |
| 1/16 x 3-6 for | 0.45 | 7" 18c; 10" 35c; 12" 45c | |

Orders for Less than $1.00 Not accepted. Add 10 per cent for packing. Special discount on orders of $5.00.

CONSTRUCT-A-PLANE COMPANY
285 Bushwick Ave.
Brooklyn, N.Y., Dept. PA

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**MODEL GASOLINE ENGINE WEIGHT 18 OZ.**

Starts easily, runs smoothly and turns propeller or flywheel better than 2000 R.P.M. In actual use on many model planes and boats.
Blue prints of boats to fit motor.....35c
Blue prints of plane to fit motor.....35c
10c brings full information.

GIL MANUFACTURING CO.
5430 Grace St. Chicago, Ill.

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**BIG CRASH IN PRICES**

These are fine quality model airplane materials, SATISFACTION GUARANTEE.

Grade A White Balsa Sheets 36" Long

10 Sheets, 1/32 x 2"....35c 10 Sheets, 1/8 x 2"....48c
10 Sheets, 1/16 x 2"....35c 10 Sheets, 1/4 x 2"....68c
1 pt. Dope or Thinner.....49c

Add 10% for postage and packing.
No orders under 50c accepted.

G. S. AIRCRAFT
DEER PARK AVE. BABYLON, N. Y.

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2485 American Avenue Long Beach, California

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### A Real 1/8 h.p. Gasoline Engine
in miniature, for MODEL AIRPLANES and boats. ¾ in. Bore ¾ in Stroke—weight 1 lb. —3900 R.P.M. GET CATALOGUE, REAL BOATS, MOTORS—FITTINGS, ETC.—only 20c (coin). **LOUIS P. LOUTREL, 96 McDONOUGH ST., BROOKLYN, N. Y.**

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### NEED BALSA?
**60c will bring you a supply of good, clean sheet, strip and block Balsa (valued at $2.00) that will last you throughout the summer. Enough to build 25 models. Odd sizes, but satisfaction guaranteed or money refunded. Real opportunity for DEALERS and CLUBS.** Complete doping outfit for 25c—2 bottles any colored dopes, 1 bottle clear dope, 1 bottle acetone. Send 2c for price list.

MODEL AIRPLANE SUPPLY—DEPT. A.
1140 53rd Street Brooklyn, N. Y.

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**THE WONDER CARVING BLADE IDEAL FOR MODEL-BUILDERS**

A folding pocket knife made to fit any old Safety razor blade. Carry it in your pocket. Made-to-order for cutting balsa wood and carving propellers. Model-Builders should order Durham-Duplex style knife for best results. Sent postpaid for 25c complete with blade.

Steel Specialties Mfg. Co., 2347 N. Nova Ave., Chicago, Illinois

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### SWIFT
Sells A Special Assortment of

**BALSA *for* MODEL BUILDING**

50 Pcs. ⅛ Sq. to ⅛ x 1, All 2 Ft. High Quality

**50c Postpaid**

SWIFT AIR-MODEL SUPPLIES
363 Brittain Road Akron, Ohio

*(Continued on page 198)*

**Advertise in this Directory. Rates: $2.00 per insertion.**

# DIRECTORY

**One-Inch Advertisements. No more — no less.**

**INVENTORS**

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Now safe, practical. Saves time, expense. Particulars free. Write

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the inventors own magazine! Sell your invention! Write today for free information every inventor should know.

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**Terms reasonable. Personal attention.**
Send model or drawing for FREE advice.
*Book "HOW TO GET YOUR PATENT" sent on request.*

**L. F. RANDOLPH,**
**REGISTERED PATENT LAWYER**
**372 Victor Bldg. WASHINGTON D. C.**

**MISCELLANEOUS**

## CABLE SPLICING
**INSTRUCTIONS**

Instructions include two instruction sheets and diagram on the Five Tuck Navy Splice. To be able to splice aircraft is one thing that Airplane Mechanics, Helpers, Apprentices and light plane builders should be able to do. Now there is no reason for not knowing how. One Dollar will bring the complete instructions by return mail.

**A. G. BRETON**
**954 Monroe Avenue, Elizabeth, N. J.**

A REAL VEST POCKET SLIDE RULE

5½ in. Long — ¼ in. Thick

Used by Technical Men for Solving Problems—Anyone Can Learn—Each Rule, Leather Case and Book of Directions, $2.50 Post Paid or $2.62 C. O. D.
H. S. DURLAND, 61P Hinsdale Pla., Newark, N. J.

## CALCULATIONS

of all kinds quickly made with the Midget Slide Rule. Multiplication, Division, Addition, Subtraction, Proportion, all Roots and Powers. Gives Trig. Functions to 1 Minute. Made of metal, Dia. 4 in., Wt. 1 Oz. The Engine-divided scales are on white enameled aluminum, all readings taken under a hair-line. Price with Fabrokold Case & Instruction Book, $2.00. Cash or C.O.D. Circular free. Your money back if you are not satisfied.
**GILSON SLIDE RULE CO., Stuart, Fla.**
(Slide Rule Makers since 1915)

**A Masterpiece for American Craftsmen**

**6 Ft. "FlexRigid" Steel Rule Tape, coiled in a nickle plated case. Serves as a rule or steel tape. World's best steel. $2.00 Postpaid or $2.12 C. O. D.**

**H. S. DURLAND**
**61p Hinsdale Pla., Newark, N. J.**

## WARTIME PLANES

For sale: Hundreds of sharp, clear, **actual photographs** of pioneer, wartime, and modern airplanes. All 7½x9½ inches in size. Send for free list and please mention Popular Aviation.

**R. R. MARTIN**
**1615 N. Western Ave. Hollywood, Calif.**

**Boys! Build This Baby Car for Less Than $10.00!**

Runs 40 m.p.h., 150 m.p.g. gas. Carries 1 or 2 persons. 65" long, 24" high, 30" wide. 3 h.p. engine. Built easily by anyone.

**$1** brings large clear blueprints, 3 photos, and 3000 word Instructions to build complete (including engine) for less than $10.00! Not an experiment, but a sturdy, practical and reliable baby car that will give you and your pals loads of fun. Send $1.00 bill now.
**MIDGET CAR CO. Dept. 529-P Kearney, Nebr.**

## IMPORTED FROM FRANCE

Genuine World War Souvenirs. Newport 28 pursuit plane ailerons covered with insignias, excellent wall decorations $2.00. German propellers $5.00. Lightweight Gnome cylinders for ash trays polished 50c, 3 for $1.00. Gnome 165 piston rings make perfect paper weights, postage paid, 5c each.

Send postage for lists
**MARVIN A. NORTHROP AEROPLANE CO.**
**730 Washington Ave. N. Minneapolis, Minn.**

## Save MOTOR REPAIRS use . . . PYROIL

Pilot Gerald Kohner flew a Sparton PYROIL-treated plane 35 minutes, no oil in crankcase, no damage! Proving new safety factor effected. Write for the amazing "Story of Pyroil."

PYROIL CO.
W. V. Kidder, Pres.
91 LaFollette
LaCrosse, Wisc., U.S.A.

(Simply add to Regular Oil)

## ASTRONOMY ENTHUSIASTS

Would you like to own a powerful reflecting telescope? With our materials and instructions you can make one with a diameter of 6 in. for only $10.00, including eyepiece. Other sizes, 4 in. to 12 in. Not toys, but materials for real amateur telescope making, offered by makers of telescopes for fourteen years. Write for information, addressing Dept. B.

**TINSLEY LABORATORIES**
**3017 Wheeler St., Berkeley, California**


**Fred Krug**
*(Continued from page 182)*

not seem to be moving so I held my breath and decided to try and land. I had read time and time again, the operation of a plane in flight and had practised on imaginary pedals and stick the different maneuvers. I gently eased the stick forward and shut the throttle way down.

"The ground seemed to be coming up, toward me awfully fast. When I was sure the ground was going to stop me —prop first—I pulled sharply back on the stick, bounced a couple of times and came to a stop. The bouncing must of brought you to, for you turned and wiping your eyes, looked around. It was a few minutes before you did say anything and then it was wow."

That, folks, I think is a record. A boy barely 17, soloing in 15 minutes without even complete instructions. I did not want the officials at the field to know I had fainted at the controls for my pride's sake—and other reasons. I asked Fred to keep it quiet and he promised.

Well, I am in town again and think that credit should be given this boy. He lives, I think, in a place called Roselle Park. If he reads this article, I wish he would get in touch with me.

He is, in my estimation, a regular American boy. He did an almost impossible feat with the skill of a veteran pilot and kept mum about it through loyalty to an almost total stranger. He is fine, and I think the aviation world will hear great things from him.

Please print this story in your magazine so that I can give the credit to this boy I owe him.

END


# CLASSIFIED DIRECTORY

**Rates 10c per word**

**ADVERTISING AGENCIES**

ADVERTISE. Inch display 52 magazines, three months $6.00. Pennell Standard, Covington, Kentucky.

ADVERTISE—We help you market your product. 24 words in 24 representative Sunday Newspapers, $15.00. Helpful newspaper, magazine Ad-Guide, 4c. Wade Agency, 20 W. Jackson, Chicago.

**AGENTS WANTED**

BIG MONEY APPLYING GOLD INITIALS on automobiles. Easiest thing today. No experience needed. $1.45 profit every $1.50 job. Free Samples. "RALCO", L-1041 Washington, Boston, Mass.

300% PROFIT selling mystery gas lighter. Retails 25c. Costs $1.00 doz., $9.00 gross. Sample 10c. Square Deal Co., Desk PMX3, Bradford, Pa.

**AIRPLANE SUPPLIES**

SPRUCE—For Lightplanes. All sizes. Inquire Economou Airplane Company, E. Georgia, Vt.

**BOATS**

BOATS!!!! BUILD YOUR OWN BOAT. Start planing now and build during your spare time this winter. Save 2/3 Builders Cost using our knock-down ready-cut materials, 82 designs. Also complete line fittings, propellers, shafting, etc. Send 10c for catalog. BROOKS BOAT CO., INC., Box V38, Saginaw West Side, Mich.

**BOOKS**

GOOD BOOKS—Stamp brings circulars. Golderod, Dept. 200, Harrisburg, Ill.

**BUSINESS OPPORTUNITIES**

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*(Continued on page 199)*

## Berk's Plane

(*Continued from page* 183)

This, with an OX5 motor, will make it a safer three-passenger plane, especially for amateur use. I am hoping it will fly as easily as the little plane does. Will be glad to send you some snapshots of it when finished. I could keep right on writing from one thing to another, but will stop right here and wish all the boys building their own plane a lot of success, and above all—to be careful. It will pay them many years of happiness.

Glad for the Howl Department in P.A. Michigan has not shut down on identified planes as yet and I've been holding my breath for the last year for fear they will. I sure hope your agitation will do a lot of good for us. If there is anything I can do to help give us our freedom in flying our own planes I'd sure be glad to do it.

Yours respectfully,

Glenn W. Berk.

## Airports

(*Continued from page* 160)

Those airports which receive a rating of "A" on aeronautic lighting equipment from the Department of Commerce must have, together with other equipment, a beacon of either the rotating type or the fixed type with a flashing light source.

If of the former type, it must have a color characteristic consisting of either clear flashes or a combination of clear and aviation green flashes, operated so that six clear flashes per minute will be shown in addition to any green flashes. The latter type of beacon must have the same color characteristic and also must have a definite international Morse code characteristic.

The beacon itself must qualify in any one of the classes embraced in the following: Beacons having a maximum candlepower of not less than 1,500,000 candles and a luminous period of not less than 1 percent.; and, beacons having a maximum candlepower of not less than 10,000 candles and a luminous period of not less than 35 percent. The latter must also be aviation green in color. The luminous period designates the percentage of time during which the beacon is lighted, to that during which it is dark.

In event that the main beacon is not green in color and does not include one or more green flashes having a maximum candlepower of not less than 10,000 candles, an auxiliary double-light-source beacon, aviation green in color and flashing the international Morse code, must be installed on the airport in addition to the main beacon.

The illuminated wind cone that you have seen at your airport is either illuminated internally with a lamp of at least 200 watts, or externally with four or more 100 watt lamps. Boundary lights are usually spaced at not more than 300 feet apart and are served by an underground distribution system. Green lights are used to indicate the ranges of each landing strip or runway, while clear or yellow lights are used in the boundary-light system if the entire area of the field is suitable for use.

Great stress is placed upon illuminating obstructions such as supporting towers for power transmission lines, chimneys, water towers and the like, especially when they exceed 100 feet in height. Red lights, one-third and two-thirds of the height of the obstruction are most commonly used.

The development of landing flood lights has been interesting in aviation. The present type in use makes it possible for the pilot to correctly judge the distance to the ground from an altitude of thirty feet and, in this way, makes them invaluable for night work. Many airports use flood lights to show the exterior of all hangars, etc., increasing the general visibility of the port after dark.

The government places great importance on the marking of air terminals. The cross country pilot, unfamiliar with the terrain below him, will be puzzled by seeing a marker, "John Jones Airport", with no mention of the town. For that purpose, it is much more desirable to have the field marked "Burlington Airport" than the name of the individual. Even in localities where there is no air field, any reader can perform a great service by seeing that one prominent building is marked in some intelligible fashion or another. Most important of all, every Chamber of Commerce should keep its eyes aloft in order that their city will be able to profit from a well-equipped and designed airport which they will find necessary in the near future.

END


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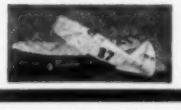

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## Airy Chat

(*Continued from page* 142)

*I've been reading your magazine and some of the guy's that write to your magazine ought to see a doctor. I am an amateur like the rest.*

*For the "love of pete" tell these ("big") flyers to get a little sense. Just a little won't hurt them any.*

Well, this is the other side of the story but we would like to have further details as to specific cases, just as the others have written in their letters. I don't think that the great majority of our correspondents claim to be big flyers, nor do they intend to show the big companies anything. All that they desire is the privilege of working along in peace without a government representative horning in on their every move.

* * *

CHARLEY and Jim will now entertain you in place of the late lamented Bob and Ed in the old "Practical Lessons in Flying."

In the new course, the subject of meteorology is debated between Jim the student and his old Friend Charley who is instructor in a flying school.

* * *

HERE'S good news for someone with a little cash. Charles F. Abel, Palatine, Ill., has a Standard Heath Parasol with a 30 h.p. Lawrence converted engine for sale. He says the ship is in good shape and flies well with the Lawrence engine. He will sell the plane complete with the engine for $100.00.

* * *

HERE is a timely suggestion from one of our Airy Chat readers in reply to a paragraph in a recent Airy Chat. We thank Mr. F. A. Jennings.

*I have long intended to write you one thing. You said that somebody might eliminate the dust clouds at airports. I am no sort of an inventor, but I think that calcium chloride would do the trick. It is what is called "deliquescent" for it absorbs moisture from the atmosphere, keeping whatever it touches damp.*

*I think this would do it, as it is used for gravel roads, the moisture absorbed keeping down the dust. It is the by-product of many manufacturing industries, and as there is not much demand for it, the companies would be glad to sell it at very cheap rates. One application is good for a week or so. It will work in the driest weather.*

Well, what did I tell you fellows? We only have to suggest the need for something and right away we get the answer. We again thank Mr. Jennings for his interest and cooperation.

* * *

Well, it's closing time for this Airy Chat. So long—I'll see you later.

J. B. R.


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LEONARD HICKS
Managing Director

## Meteorology

(*Continued from page* 172)

ever, Jim, it's a fact. You know, of course, that when you get up quite a ways the oxygen sort of peters out, and so do some of the other ingredients. And while I have never been that high in any ship I ever flew, I know if you could only go high enough you'd find there was absolutely nothing at all after you got up twenty or thirty miles.

NOW here's another interesting fact. Air has a very definite weight. In fact, it only takes 12 cubic feet of the stuff to weigh a pound. Not a very hefty substance, Jim, but when you get air in gobs it weighs quite a bit. For instance, the air in a room 60 feet by 30 feet by 15 feet weighs more than a ton! In an ordinary sized room there is more air by weight than an average man can lift, believe it or not.

Now, Jim, this is the case for dry air, but free air can absorb a great deal of moisture from various sources, and when it does, the mixture of air and water vapor weighs much more than the dry air.

When moist or "humid" air is warmed, its capacity for moisture is increased so that warm free air contains more moisture than cool air.

BECAUSE air has weight, it is easy to see that it exerts pressure against any surface immersed in it. That is, Jim, every living thing on earth is immersed in air that presses down on it from above and from all sides with a pressure of approximately 14.7 pounds per square inch at sea level.

To get an idea of this, try to imagine a man on whom some one dumped a feather bed or a carload of sand. This pressure at the earth's surface is known as atmospheric pressure. It is similar to water pressure because air, like water, is fluid and exerts a pressure on every side of an object immersed in it.

I have gone into this matter of atmospheric pressure, Jim, because that is the little old lady that causes most of the phenomena we know as "weather". Fluctuations in this pressure are responsible for movements of air in the form of winds, storms and cyclones.

I've got to close this screed now, Jim, as it is way past my bedtime and we old fellows have to get our beauty sleep. Next time I write I'll try to give you the dope on measurements of various atmospheric phenomena, something about the instruments you should be familiar with, and, if I have time, a little discourse on clouds.

Meanwhile, let's hear from you soon, and give my regards to that bandy-legged pilot-instructor named Martin in your outfit—the one with the beak like Jimmy Durante—and tell him if he ever sets his ship down in this field it's going to be just too bad. And that goes for you, too, Jim, you old walrus-eyed waffle!

Yours,

Charley.

## Floats

(*Continued from page* 169)

compiled, a complete set of lines should be faired on a half-size layout. This is done to eliminate any irregularities in the contours of the float, as offsets taken from small scale layouts will involve surprisingly large errors. The half-size lines should be faired by means of full length wooden splines or battens.

Parts involving complicated curves should be faired by the system of water lines and buttocks, which is simply projecting the curves where the water lines or the buttocks intersect the surface into a right angle view. Any irregularities of the surface will become immediately apparent.

The spacing of the frames and floors should be undertaken next. This will depend upon the gross weight of the seaplane, the type of construction and material used. The spacing can best be determined by making a brief loading analysis, using required loading as specified by the Department of Commerce in Bulletin 7-A or by the Military Services. The position of the frames and floors should be located on the half-size layout and offsets for detail design measured from them.

There are several types of construction which may be followed with confidence and the designer should have no trouble on this score.

END

## Radio Beams

(*Continued from page* 152)

Say that a patch of bad weather exists on the course—the departure point and destination being sufficiently clear to take-off and land. As most bad weather comes in low with a limiting ceiling, the pilot can climb over or go through the low ceiling as he will. He keeps course by means of the beam.

Formerly, a bad stretch of weather meant the cancellation of the flight, especially if passengers were concerned. This occurred when the bad spot was large in area. By use of the beam, a flight can be made over a course 80 percent. bad weather, the only requirement being a clear landing area. Department of Commerce rulings on this bad weather flying forbade flying through under a 500-foot ceiling. This rule is to be waived. The decision for the flight rests on the pilot, unless impossible flying weather exists. In these extreme cases the flight is cancelled from the operation's office of the line. In general, passenger pilots are required to use more discretion in bad weather flights than are the pilots of the mail planes.

They, the mail pilots, were the ones that caused the upset. They flew the beam in weather that was fit to be called "pea soup", inventing the process of "drawing-in". With their parachute as an ace in the hole, they dared the weather to do its best to force them down.

Now comes the training of the pilots to fly this beam through the "soup". Radio keeps him going in the right direction. As to how he goes depends upon himself. His ability to fly by instrument needs be highly developed. When the natural check point, the ground, disappears in scud, fog or mist, he must turn to these instruments and believe what they tell him.

That is the secret of instrument flying—believing in the instruments against his own sense of balance. The interpretation of the instruments is easily learned, but the belief comes hard. Once the lesson of faith is digested, instrument flying becomes a matter of experience. Blind flying becomes instrument flying, the plane goes through and the schedule is kept.

So many articles have been written on the subject of flying by instrument that it will not be discussed or expounded here. For those who wish to learn more of this subject, Howard Stark, veteran mail flyer and instructor of the pilots on the Eastern Air Transport, has a book on the subject.

Let it be known that it requires no super-pilot to do this work. Pilots have taken off blind from a runway in bad weather with 200 and 300-foot ceilings all along the course. With their skill at instrument flying and the Radio Beam, they made the flight under conditions that formerly were impossible.

The installation of beacons has made night flights a much easier matter. The beacon acts as a lighthouse and the flying is no more difficult than flying from one light to the next. The more experienced pilots fly a course parallel to the beacons.

The safe axiom of beacon flying was "a beacon ahead", meaning that the flight continued as long as the next beacon was visible from the one underneath. As the beacons are sometimes flown when the visibility is so poor that the beacon cannot be seen until directly over it, perhaps the axiom—not the ruling—may go the way of the 500-foot ruling. Bad weather calls for a combination of the beacons and beam.

One-way communication is made possible by means of the beam. At stated intervals, the beam signals are shut-off and the weather is broadcasted to the pilots enroute. This gives the course weather, the local weather and any special features or local conditions of interest to the pilots. The pilot can determine from these reports, also with the reports given him at his last stop, just what the weather is going to do. It is equally important for him to know the conditions behind him for he may have to retreat or seek landing fields to the right or left of him.

Having this continuous weather data, he can plan his flight and navigation according to conditions. This beam information is called "One Way Communication." On planes where space and weight carrying ability permit, the "Two way Radio" is installed. With this the pilot can communicate with the ground stations of his line. He gives his position, weather dope for other pilots, company business, etc. The stations in return give him weather conditions, local conditions, such as smoke, haze, new obstacles, etc.

So the weather observation may be termed the "Spy system" of the pilot's army. The Intelligence Corps watches the weather for the slight change, passing it on for the information of those concerned. They can now make preparations for the battle it may give. The Beam gives the weather, two-way gives the weather and the stations furnish a written weather report to the pilot, all of which are concerned with weather.

On the pilot's shoulders rests the burden of condensing the information furnished. He must perfect himself in the use of the mechanical aids made for his use. Radio, Weather Man, Pilot, Navigator—his schooling is not yet ended.

To the many knowing the obstacles, the marvel of a printed schedule of operation is still a miracle. To run an established schedule over a nine hundred mile run was a dream disbelieved by even the most optimistic. But it was done. Now the transatlantic run is next.

END


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